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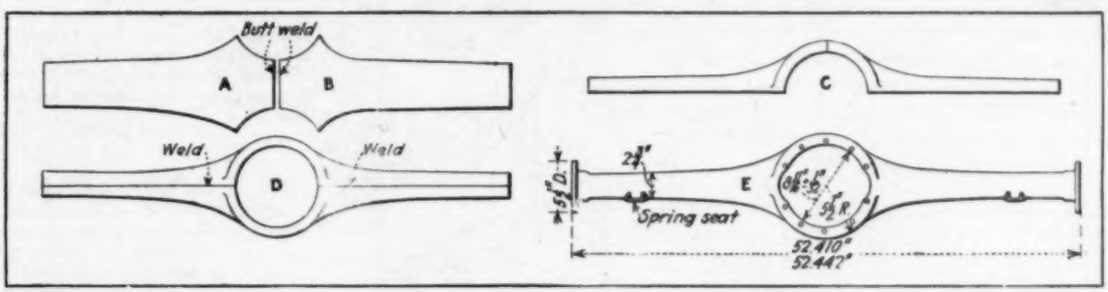
Dies and Tools

for Four-Piece Rear Axle Housings



By Frank W. Curtis

BECAUSE of the many improvement changes made in the design of rear axle housings, the Chrysler Corporation, Detroit, Michigan, found it advantageous to lay out a new department for their manufacture. Inasmuch as the housings used in the different models of cars are similar in construction principles the same equipment is used, only a few tool changes being necessary.

The finished housing is illustrated at the lower right in the headpiece. It is made of four sheet metal blanks welded together. At *A* and *B* two blanks that form a half section are shown. These are welded together as indicated on the drawing. The welded unit is shaped to the form shown at *C*, and finally two halves form the housing, as shown at lower left.

It has been found more economical, in both time and material, to make the housings from four pieces instead of two. The steel from which the housing is made is $\frac{3}{16}$ in. thick, and the first operation is to shear the sheets into rectangles of convenient size for four blanks. This is done so that the sheets may be reversed after the first blanking operation to conserve material.

The fabrication operations precedent to machining are: Blank, butt-weld two quarter sections together, remove flash at welded joint, form fold at differential housing openings, rough shape halves to form, finish shape halves, cut notches in fold, weld halves together, trim outside flash of weld, broach inside flash, grind outside surface at weld, flare both ends, inspect. Following these operations, spring pads are welded to the housing and it is then sent to another department for machining and other finishing processes.

A view of the blanking press is shown in Fig. 2. Here

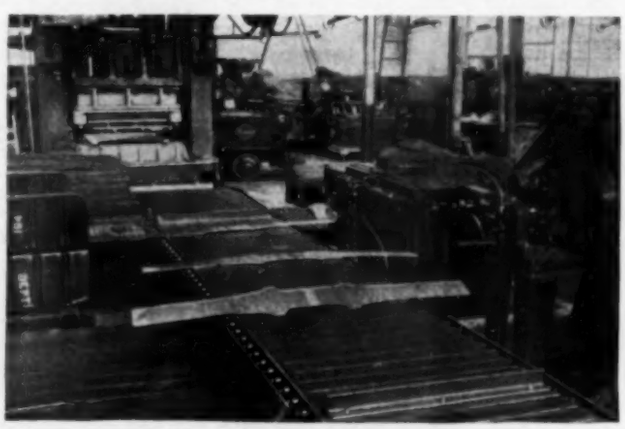


Fig. 1—Since the work is somewhat large, conveyors, racks, and stands are utilized at convenient points to aid in transporting it between operations. This conveyor transports the work from the blanking press to the drawing operation, likewise serving the butt welder, the flash trimming machine, and the press for hemming the banjo face

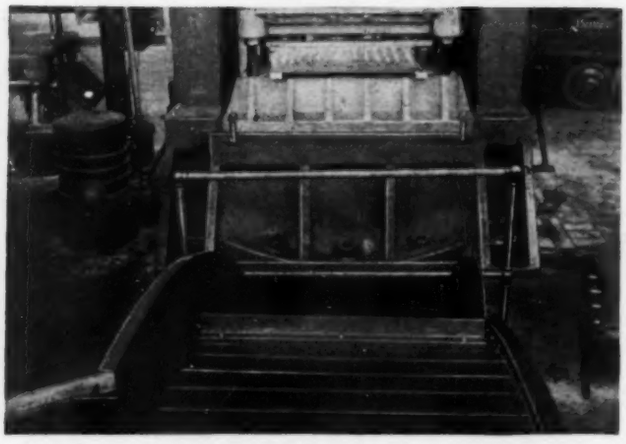


Fig. 2—As the quarter sections are blanked they fall through the die to a conveyor that passes through a pit located under the press. This method of handling saves considerable time since it is necessary only for the operator to remove the scrap sections of the sheared stock. Two pieces are blanked in the same operation

a cast steel shoe. The punches are made of 4 sections and are attached to a punch holder that is fastened to a plate. The punch plate, in turn, is attached to a cast steel shoe. Four guide pins are used to insure alignment. A clearance of 0.0075 in. is made between the cutting edges of the die and punch.

The machine used for butt welding the quarter sections together is illustrated in Fig. 5. A blank is placed in each of the copper jaws located at each end of the welder. Because of the shape of the part it is not necessary to provide elaborate clamping devices. The blanks are held from backing away by stop plates, positioned at the outer ends, while two water-cooled swinging clamps, located nearer the edges to be welded, are insulated from each other and form the contacts for the welding current. The toggle joint arrangement, seen at the end of the machine, moves the table forward at the proper time and finishes the weld. After the blanks are welded, the operator passes the joined unit to the operator of the trimming machine shown at the right of the welder. Here, it is passed through an opening barely wide enough

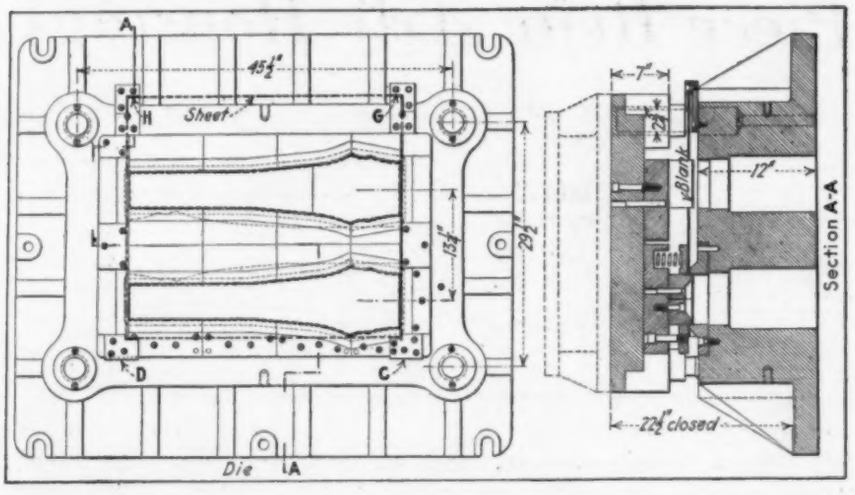
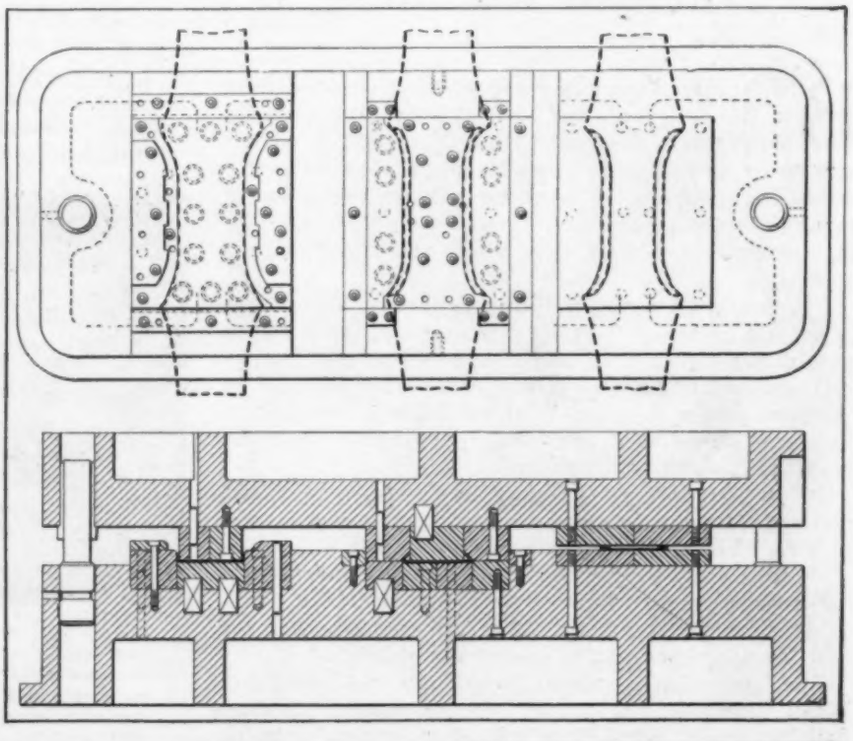


Fig. 3—On account of the size of the blanks, sectional dies and punches are used. Each die section is made of ten pieces of hardened tool steel, while the punches are constructed of four pieces. This design lowers maintenance cost, as well as simplifies the die construction. The dies and punches are backed up by cast-steel die shoes

Fig. 4—Folds are formed at the banjo face in a three-section die. The first operation forms the edges 90 deg. from the body, the second partially closes the edges, and the final stage completes the seam. The operation is performed by passing one piece of work through the die at a time

is seen the method of transporting the blanks from the press. As the blanks are cut, they pass through the die and fall onto a conveyor which passes under the press, below the floor level. Constructional details of the die are illustrated in Fig. 3. The die is double, and blanks two pieces simultaneously. Four pieces are cut from each strip, necessitating two operations. The sheared stock is placed in the die against the stops *C*, *D*, *E*, and *H*, for the first two blanks, then it is turned end for end and relocated against the stops for the completion of the next two blanks. At the left of the illustration is shown the die construction, while at the right may be seen a sectional view of the punch and die in the cutting position.

On account of the size of the blanks, it is necessary to use sectional dies. This feature not only simplifies construction but lowers the maintenance cost. Each die is made of ten pieces, attached to and backed up by



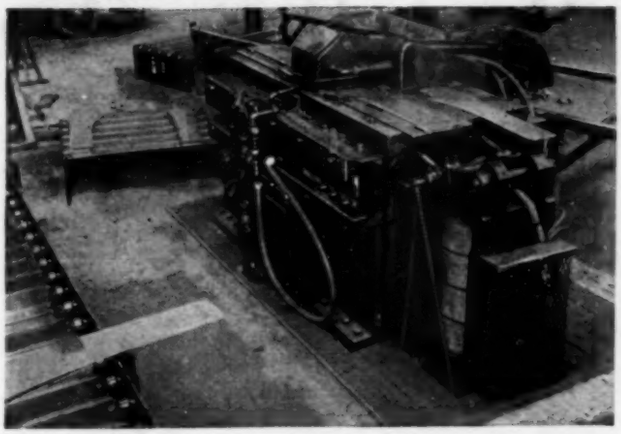


Fig. 5—In butt welding the quarters together, a piece is placed in each of the copper jaws located at either end of the machine. Stop plates are used to prevent the work from backing away while being welded, and two swinging clamps positioned close to the edges to be welded prevent the blanks from raising

to accommodate it, and the flash is removed from both sides by revolving cutters. The narrow slot, the weight of the part, and the cutters turning in opposite direction, are sufficient to hold the piece without clamping. It is fed manually. After this operation, the part is returned to the conveyor and carried to the next operation, that of folding or doubling the edges of the opening of the differential housing.

The folds are formed at the center section of the flat halves in the die illustrated in Fig. 4. Three operations are required: The first, bending the edges 90 deg. as shown at the left; the next, partially closing the fold; the third, flattening the fold, as seen at the right. Each piece of work is carried through the three dies as three steps in a single operation. The die is of the sub-press type, having two leader pins for alignment. It is not fastened to the ram of the press.

Following these operations the work is ready to be shaped and then welded in pairs to form the complete housing.

Is the Toolroom Passing?

By George A. Greetham
Toolroom Foreman, Becker Brothers Electric Corporation

RECENTLY, an article in a Chicago publication extolled the benefits of "farming out" die-making and toolmaking work, and abolishing the toolroom. No manufacturing plant can grow in size without development and experimental work, and where is there a more fitting place than the toolroom? Possibly, the jobs turned out are a little more expensive than they should be, but time is also an important factor.

Is there a manufacturing plant anywhere that has not a lathe for tool work, even though it be in a dark corner? Suppose the toolroom were abolished. Soon there would be a pulley to be rebushed, or a machine to be repaired. A machinist would be hired to do the job, and soon he would be turning punches for dies or some similar work. Then he would ask for an increase of wages, and if he were good, he would get it. Then he would want a drill press, and so on until the plant was finally back to the same condition it formerly was in, with a little toolroom in a corner.

SEEN · AND · HEARD

By JOHN R. GODFREY

Tungsten-Carbide Tools—Half-Truths

THE new tungsten-carbide tools contrive to afford almost unlimited topics of conversation in many shops. You can find any opinion from complete success to dismal failure, frequently in adjoining plants. And, unfortunately for industry, there is seldom sufficient data on which to base conclusions that help very much in deciding on the use of these tools in other work. Although experimental work is being done constantly with these tools, methods of application in a great many fields have been but partially worked out.

Comparatively few shop men seem to have either the time or the experience for conducting tests that will serve as a sound basis for general shop practice. They know perfectly whether the tool stood up, saved machining time, or failed on a particular job. But if it failed, they may not be able to say whether the tool crumbled on account of brittleness, or because it, or the work, was so badly held as to permit spring and undue vibration. And it's very important to know which caused failure, before we can plan intelligently on its future use.

* * * *

HALF-TRUTHS are frequently more dangerous and do more harm than outright lies. The lie can be nailed while the half-truth must be explained. And even straight-forward explanations frequently leave a trace of doubt as to whether there was not a grain of truth in the original statement.

A case in point is the statement by a well-known automobile production man, in a paper before a technical society, that tungsten-carbide tools could not be used successfully on a certain type of machine tool. This was backed up by tests on the machine in question which bore out the statements perfectly.

The Ethiopian in the cordwood was that the machine in question was seven years old, had seen very hard service with a minimum of maintenance, and was not in condition to make satisfactory service possible. As a matter of fact these same tools are being successfully used on this type of machine in several plants and by the builder of the machine itself. But the half-truth has gotten in its fine work and I ran across it in various sections of the country.

If more of us would stop a moment to consider whether a statement of that kind was reasonable or not, before accepting it as true, half-truths of this kind would not do so much harm. If we asked ourselves if there was any good reason why the tools should not work on this type of machine, under proper conditions, we would place less reliance on reports of this kind.

In other words, it might pay to encourage a "doubting Thomas" spirit when forming opinions on reports that are either very good or very bad. If we will ask ourselves if a statement is reasonable before tucking it away as a fact, we will form more rational opinions and be of more value to ourselves and others.

Motor Operations

Fig. 1 — Ferracute notching press, used for blanking slots in the field laminæ of large units. The blanks are registered from, and driven by, a notch in the outer rim, and are held down by light springs in the ring

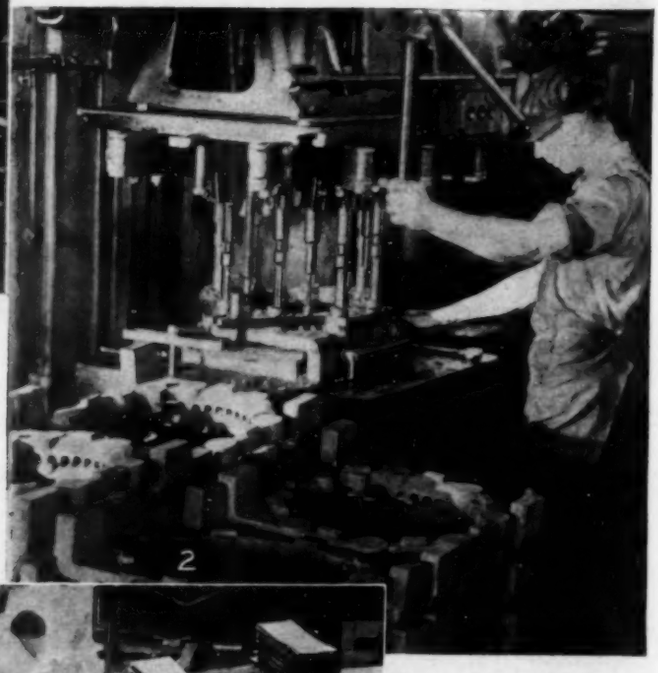


Fig. 2—Frames for fractional horsepower motors are thoroughly tooled, and are put through the shop in economical manufacturing lots

Fig. 3 — Where the demand for a certain size of small motor is not sufficient to justify the construction of compound dies, the laminæ are notched, just as in the larger sizes

ns on the West Coast

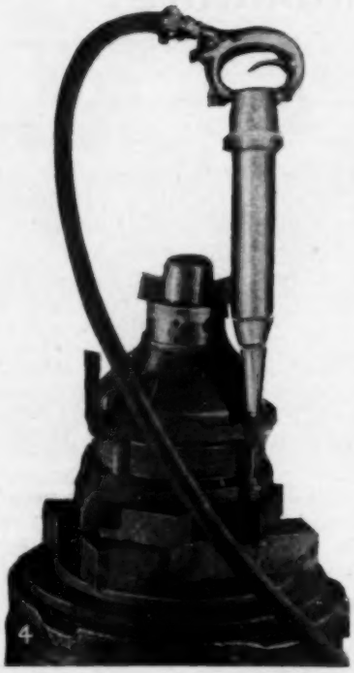


Fig. 4—The horsepower of fractional horsepower motors is regulated by using different quantities of the same diameter core iron

Fig. 5—The absence of blur on shaft and armature, show this rotor to be in balance

Fig. 6—On some types of motor, the spider, end plates, and fan blades are cast onto the armature. The metal used is usually an aluminum alloy

Photographs by courtesy of the U. S. Electrical Manufacturing Company, Los Angeles, California

Fig. 7—Testing motor-generator sets for noisy bearings

EXECUTIVE · FORUM

Who Should Do the Estimating?

"THIS is a new line of work for the shops, Mr. Holland, and we've had a hot argument on costs." Walter Shaw, general superintendent of the Machinery and Equipment Corporation, was discussing his problems with William Holland, the company's consulting industrial engineer.

"Our engineering department made the estimates on the job and turned in the report to me. I thought the machining estimates were too high, but I couldn't make the estimators see it. So I got Jenkins, our machine shop superintendent, to check with a couple of his foremen. My suppositions were confirmed, and we revised the estimates. Now Jenkins is on my trail to have all the estimating done in the shops."

"That's rather unusual today, except in small plants," replied Holland. "Why does he think it should be done there?"

"Let's call him in and ask him," responded Shaw. "Sit down, Jenkins, and tell us your story on estimating," said Shaw when the machine shop superintendent arrived.

"There's not much to tell, Mr. Shaw," replied Jenkins. "I don't see why we need estimators on our work here, particularly because there seem to be big differences of opinion between them and the shop.

"In the Crowell plant where I came from we had a couple of good technical men who collected the data from the foremen and then did the compiling and figuring. In the place I worked before that they didn't have even this type of estimator. An experienced clerk from the engineering department took the blueprints around the shop to get the estimated times from the foremen, after which he figured the cost and had it checked by the engineer."

"Who was held responsible for the estimates in each case?" asked Holland.

"In the Crowell plant the foremen and estimators were held responsible jointly. In the other shop the foremen were held for the estimate data but not for the mathematical compilation."

"Do you believe it's possible to get better results that way, Mr. Holland?" asked Shaw.

"Yes, in many cases," replied Holland. "No one recognizes the little differences between jobs like the foreman, and no one is in a better position to know when some peculiarity of design is bound to increase manufacturing costs, or when some short cut in methods will lower them. The estimators, on the other hand, are not highly skilled in shop technique. Otherwise they would be running the shop departments."

"Would you recommend that we do away with our estimating department?" queried Shaw.

"Let me reply by a couple of other questions," countered Holland. "Could you get two or three good men in your estimating department who would be willing to check their work and share the responsibility for it with the foremen? Don't foremen try to protect themselves by being liberal in an estimate rather than by giving actual facts? Don't you need perspective in your estimating work rather than just the close-ups on details that the shop men would supply?"

What Do You Think?

The foreman, with his detailed knowledge of processes, can give valuable information regarding the time and cost of doing work. Is he, however, qualified to prepare estimates? Can the work be done better by technical estimators? Is a combination of these methods most desirable? In each case, which factors of importance are likely to be overlooked? Manufacturing executives are invited to present their experiences and opinions on this topic for publication in the Executive Forum.

Topic suggested by H. M. Darling, Engineer, Wells Tap and Die Company

DISCUSSION
OF PREVIOUS PROBLEMS

Does A Highly Developed System Pay?

The question under discussion seems to be, shall system run management, or management run system? In this particular case, the superintendent was very weak to allow a few papers to retard the progress of a very important order. He was waiting for the system to function. This is a very good example of system running management.

Such a condition arises many times in new installations when all executives are not in accord with the new methods. They are tempted to sit back in the chair and say, "I ran this plant efficiently. Now let's see what this system can do."

Any system of management is only as good as the supporting organization, and in the present case the support was very weak. The idea of any system of production control is to relieve the executives of the detail work so that their time will be available to instruct and guide the organization. —W. H. TABOR, *Gilbert & Barker Manufacturing Company.*

Hiring Men from Other Shops

One scheme that will facilitate the hiring of men is to have the manufacturing plants of a locality organize a central employment association with offices near the center of town, or near some important transportation terminal. This association should have a complete card-index file listing alphabetically all employees of plants within the district. A cross-reference index should list employees according to individual factories.

There are many advantages to such a plan. First, when a man comes from a neighboring town to look for work he will not be forced to tramp about all day, but can be put on track of a job at the central office. Second, when one of the subscribing firms needs a man, it can secure him through the central office, where available men can be encouraged to file their names. This plan need not mean that individual factories would be robbed of men by other factories, but it should provide an opportunity for a man occupying a minor job in one company to secure a better position in another. Third, when men are laid off for good reasons at one plant, they can be placed elsewhere immediately.

Fourth, the plan would eliminate floaters and keep the people of the home town employed at home. Fifth, a small clerical force could take care of all the personnel records, doing away with a large staff and extensive records at individual factories. Sixth, inefficient and unscrupulous employment agencies, which charge high rates without rendering adequate service, would be driven from the field.

—F. A. SCHMIDT, *Industrial Engineer, Western Electric Co., Kearny Works.*

What Should We Teach Apprentices?

No firm will be the ultimate loser by giving apprentices the best possible training, not only in workshop practice, but also in allied theory. A program carefully considered covering the entire cycle of manufacturing, should be arranged so that the boy will not spend all his time in one department, but will be shifted from machine to machine, and from machine to bench, as he acquires the skill necessary to do the work. If possible he should also be given facilities for securing a rudimentary knowledge of auxiliary trades. Arrangements can usually be made with the local educational institutions to provide suitable classes, say on one or two afternoons a week. This opportunity, supplemented by evening study, will enable the hard-working apprentices to obtain scholarships to engineering colleges, and return fitted to fill vacancies in the higher executive positions.

Given a sound and attractive apprenticeship scheme, not only will the best type of boy be obtained, but a useful reservoir of superior personnel will be assured. The reputation of the company will be enhanced materially, thereby influencing favorably the minds of potential customers. A number of young men will undoubtedly leave the firm which trained them but they will carry with them a friendly feeling that will be a subtle but none the less real advertisement for the company they have left. In the writer's experience those plants which care properly for their apprentices are invariably superior in every respect to those that do but little along this line.

Many concerns fail in one regard. They do not keep in touch with promising young men who have left to better their positions. Frequently these men could be induced to come back, to mutual advantage. —G. W. TRIPP, *Member, Royal Ordnance Factories Apprenticeship Board, London, England.*

Entertaining—and How Much?

All of the good at a show is not necessarily gained by mere faithful attendance at the show itself. Long hours and the preponderance of the merely curious public, make it unreasonable to expect that the biggest men of an organization exhibiting can be in constant attendance. Even if they were, it would be hard to gain their undivided attention for more than a few moments at a time. Consequently it is entirely reasonable to see the physical exhibit at the show hall, and seek specific information at hotels afterwards. Five minutes of direct conversation with the executives of a company exhibiting a product will often bring out information that could not possibly be obtained from the exhibit floor men. And if a little "sociability" becomes a part of the interchange of information, what harm in that? Despite the defections of the few hotel visitors, there is a "wad" of real business so transacted.

—ELI SMITH, *Engineer.*

Ancient Manufacturing

By DEXTER S. KIMBALL
Dean of Engineering, Cornell University

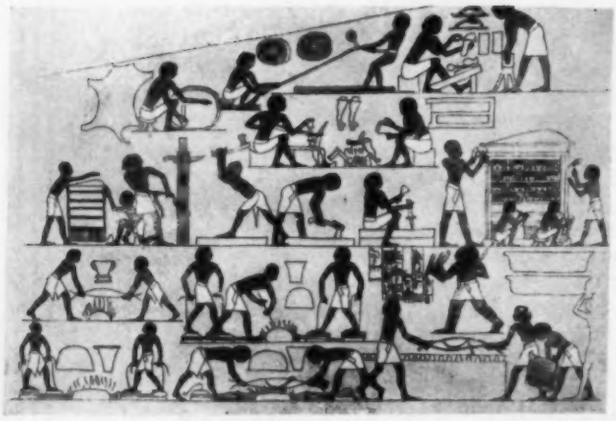


Fig. 1—Ancient manufacturing processes in Egypt

"Writers on economic subjects are prone to speak of division of labor as though it were a modern idea . . . Yet the idea was old when history was young."

WE DO not give the ancients full credit for their knowledge of manufacturing processes. The idea of division of labor, for example, was old when history was young. This is shown by Fig 1, an industrial scene painted upon the walls of the tomb of Rekhmara, prefect of Thebes, about 1600 B.C. The scene shows ancient Egyptian handicraft quite well divided, as we know it to have been. In the upper level of the picture a man is seen cutting strands of leather from a hide, in circular fashion so as to make a continuous strip. These strips then are twisted into a rope or lariat by the workers at his right. On the extreme upper right two workers are shown producing sandals. Just below, in the center, is a chair factory; at the right center, two men decorate a shrine; while at the left center, carpenters hew, saw, and construct a small shrine. In the lower band of pictures, all the processes in the smelting and casting of gold are shown. The bellows are operated by the alternate pressure of the feet. The valves are controlled by strings in the operator's hands. Here is industry diversified and classified.

Xenophon, who lived in the fifth century B.C., wrote: "It is impossible for a man to work at many things and to do them all well; but in great cities, because there are numbers that want each particular thing, one art alone suffices for the maintenance of each individual. One man gets a maintenance merely by stitching shoes, another by cutting them out, another by simply putting together the pieces. He, therefore, that is employed in a work of smallest compass must, of a necessity, do it best."

No clearer statement of the economic gains resulting from the application of the principle of division of labor has ever been made, and it is surprising that so little use has been made of it in productive processes during strenuous efforts to make a living.

Evidences that the ancients understood and practiced quantity production methods as we understand them are not numerous. It is known, however, that they did produce goods in large quantities, as is illustrated by the Egyptian pottery works at Canopus and the workshops of the Phoenicians. One example of duplicate production in ancient Egypt is given in Fig. 2 which depicts two views of a clay matrix and the little image molded in this matrix. The image is 2¼ in. high. Such little images were much used as votive offerings. The one shown was obtained personally by Prof. Eugene Andrews, of the Department of Greek Archaeology, Cornell University, during a visit to Egypt.

After the clay image was made and baked it was pressed into a lump of soft clay to form the matrix. The matrix was then baked, and the maker had a mold in which he could produce duplicate figures with rapidity. That the ancients realized also the value of some of the quantity production principles which we consider to be modern, is shown by the fact that coins were stamped in dies in very early days as numerous records show.

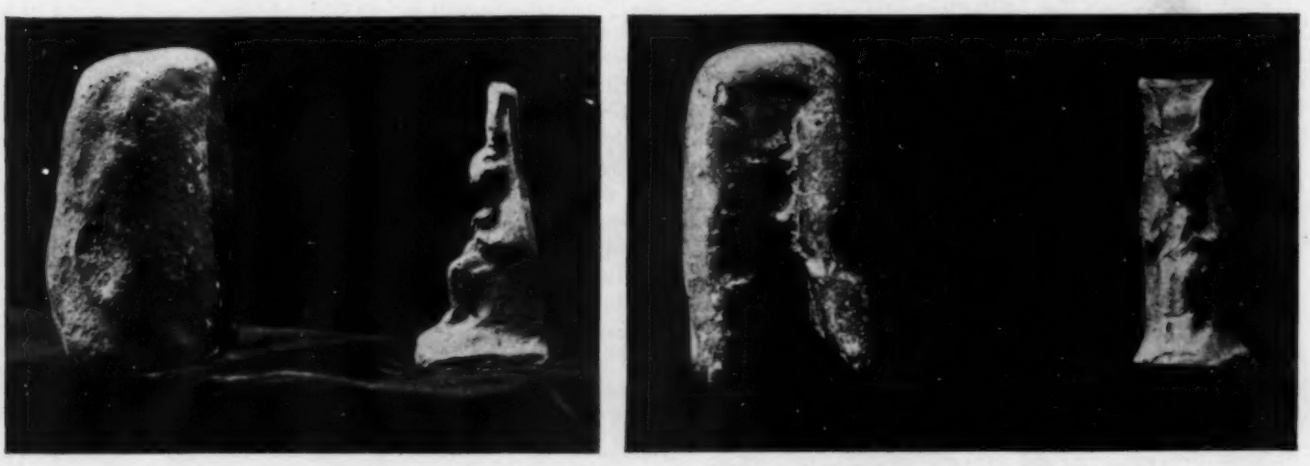


Fig. 2—Clay matrix and image formed therein, found in Egypt

Vacuum Cleaner Manufacture

in the Siemens-Schuckert Works

By Dr. Hubert Dransfeld

Secretary to the General Manager, Siemens-Schuckertwerke, Germany

THE manufacture of the Siemens vacuum cleaner, known as the "Protos," is carried on in the electric motor factory of the Siemens-Schukert Works. This factory was built and equipped specially for the production of continuous and three-phase motors of all types, from the smallest size up to 5.5 kw., and for turning out a number of small machines in which electric motors are an integral part, such as electric drills and house pumps. A special department is devoted to the manufacture of household implements. It is in this department that the Protos vacuum cleaner is made.

In Fig. 1, the general layout of the assembly room is shown. A view of the room, looking down along the assembly conveyor, is shown in Fig. 2. As may be seen in the picture, a number of small tools are installed in the assembly room. These tools are used for machining the aluminum parts. Assembly work has been facilitated by this combination. The various parts of the vacuum cleaner are produced in the different departments of the factory where work of similar character is carried on. Material handling equipment conveys these parts to the assembly room.

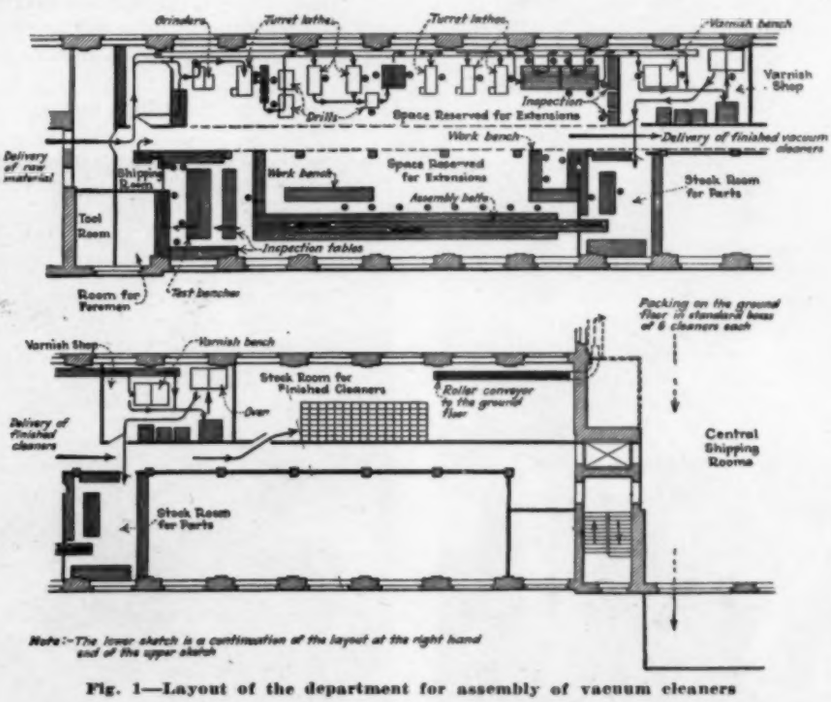


Fig. 1—Layout of the department for assembly of vacuum cleaners

The lay-out and manufacturing methods adopted for the production of the vacuum cleaner were planned to give the greatest output within a given time at the successive stages of production. All finished parts are collected in the stockroom, designated in Fig. 1, from which they are delivered to the assembly belt. The illustration, Fig. 2, shows the arrangement and location of this belt. On the left-hand side in Fig. 2 the electric motors are assembled. After inspection and testing they are returned to the middle section of the conveyor and go back on the belt to the stockroom. From the stockroom they are sent along the right-hand side of the conveyor shown in Fig. 2, together with other parts, and on this conveyor the assembly operations are performed. After the cleaners have been tested they are packed in cardboard cases and delivered to the finished stockroom by means of another conveyor of the overhead type.

This conveyor is shown in Fig. 3. It consists of a series of trolleys equipped with anti-friction bearings and driven by chain. Packed vacuum cleaners, hung from hooks, are delivered by the conveyor to a chute and slid by gravity to the main stockroom. The trolleys return down a second incline to their starting position. In Fig. 4 a close-up view of the trolley conveyor is shown.

Three different handling systems are employed to remove the containers from the stockroom: (1) A "paternoster" for carrying them to the main stockroom; (2) a chute for transporting them to the shipping room where the cleaners are packed in shipping boxes containing six each; (3) a conveyor for loading the packed cleaners directly onto railroad cars or ships.

Other material handling installations have been made throughout the plant. In Fig. 5 the method used to transport bearing brackets and motor casings from the lathes to the drill presses is shown. Chutes deliver the parts from the lathes to a belt conveyor running lengthwise through the department. This conveyor carries them to the girls operating the drill presses. In the department shown in Fig. 6 the parts are passed by hand from operator to operator between successive processes. The same plan is followed for the operations carried on along the left-hand side of the assembly line in Fig. 2. Here, however, boxes are used to carry the parts and are moved by hand from one operator to the next. These boxes run on rollers that ride on tracks lengthwise of the table.

In other departments of the electric motor factory and in the central shipping department conveyor belts are employed to handle the work. The speed of all these

Fig. 2—Motor parts are processed on the left line and come up the middle on a belt to the temporary stockroom. The vacuum cleaners are assembled on the right line

belts is adjusted so that they act as pacemakers for the various operations. This plan has maintained a steady flow of work at a high rate of production.

Vacuum cleaner casings are taken from the enameling shop to the assembly room on special racks. These racks are carried by electric trucks, as shown in Fig. 7, a total of 120 casings being carried in one load.

Production control is based upon data secured from market analysis. The output to be scheduled for each day of the month is based on data supplied by the sales department, modified by past experience in connection with seasonal fluctuations. Several years of market study have helped the company to forecast market fluctuations during the various seasons of the year. The *Electrical World* has furnished corresponding data applying to the United States. It has been discovered that the movement in Germany is almost identical with that observed in America, the sole difference being that around the Christmas season a sharp rise takes place in the German market.

No great reserve of parts is stocked at any point in manufacturing. The work is tested and inspected at various stages of manufacturing. This plan avoids accumulation of material at different inspection points. Inspectors report to the general works manager and not to department managers.

Finished parts pass from operator to operator and then to the assembly department to be made up directly into vacuum cleaners. The plant has a maximum capacity of 1,000 cleaners per day of eight hours. When operating at full capacity the stockroom for parts feeding the assembly line has space for only a few hours' requirements of the assembly department.

An elaborate system of electric recording meters keeps track of the output. In Fig. 4 it will be noted that as the trolley carrying one of the packed vacuum cleaners to the stockroom traverses the overhead conveyor in the packing department, it passes an electric contact. This contact operates the meter shown in Fig. 8, mounted in a case.

One of these recording instruments is located in the

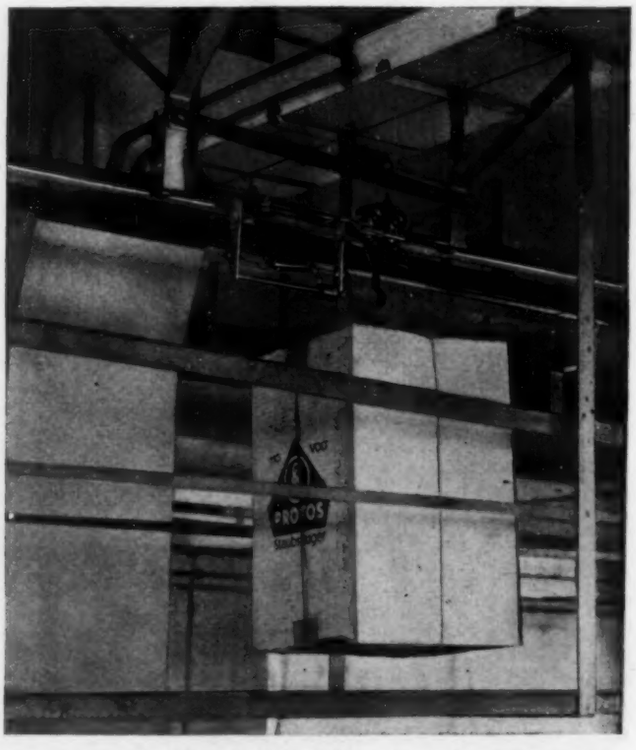


Fig. 3—The cleaners are packed in boxes, and a chain and trolley conveyor takes them to a chute leading to the stockroom. Fig. 4—In this close-up view of the chain and trolley conveyor may be seen the electric contact that registers the output on the meters shown in Figs. 8 and 9 as the boxes of cleaners pass along

foreman's office, one in the superintendent's office and one in the manager's office. The lower line of figures indicates the number of cleaners finished during the course of a current shift. The top line shows the number finished during a current week. These recorders check the delivery of finished cleaners to the stockroom, and also supply the basic data from which wage calculations can be made. The piecework system of wage payment has been adopted throughout the plant. Workmen employed on operations under the group system, such as assembling, lathe work, and similar operations, are paid according to the production of the entire group.

In Fig. 9 is shown another type of recording instrument for indicating graphically the number of finished cleaners delivered to the stockroom within any given period of time. The recording chart carries parallel lines and is actuated by clockwork. The distances between the parallel lines indicate hourly intervals and the density of the successive recorded marks between these various time intervals indicates the relative regularity of production. These charts are also used as indicators of the element of fatigue among workers, according to the various hours of the day. The electric contact on the stockroom conveyor line, which actuates the meter in Fig. 8, also operates the meter, in Fig. 9, that makes the record on the chart.

The methods of production control employed and the studies made continually to increase output without lowering quality of work have resulted in a considerable improvement. Comparison of the records between 1925, before the reorganization of the shops was started, and the present time, gives the following ratios:

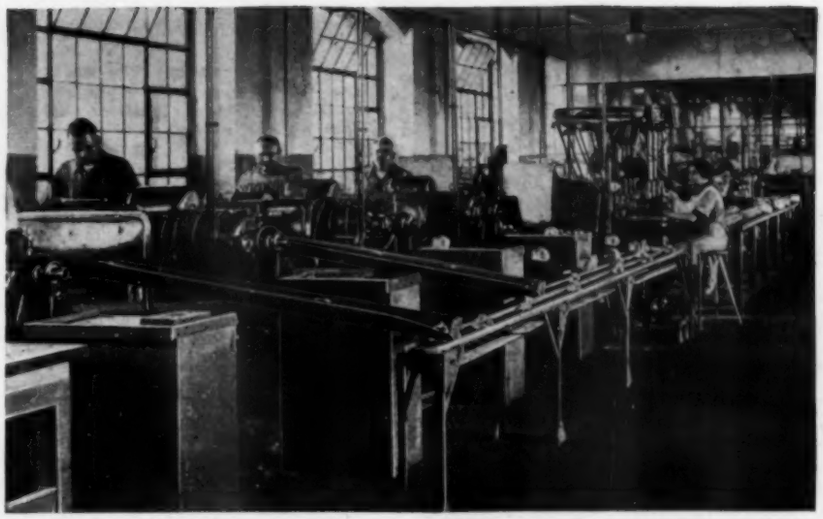


Fig. 5—In the machine shop, chutes and belt conveyors carry the parts from the lathes to the drill presses

Fig. 6—In some departments the parts are passed from operator to operator by hand. No stock of work is allowed to accumulate between processes

Fig. 7—Vacuum cleaner castings are carried from the enameling to the assembly department by electric trucks

Year	Production per Worker Within a Given Time Unit	Time Required per Piece	Average Earnings of Workmen
1925	1	1	1
1929	5.4	0.34	1.2

The figures show that the output per worker has been increased to 540 per cent of the former quantity. The time of manufacturing has been reduced to one-third, and the earnings of the workmen have been increased by 20 per cent. Similar relationships result when capital invested in material, and turn-over of materials are compared, each for the respective years.

Apart from the constant survey of costs, carried on by the central cost accounting division of the plant, certain methods are in use for pre-determining costs and consequent market prices for the cleaners, on the premise of a growth in sales volume and a parallel continua-

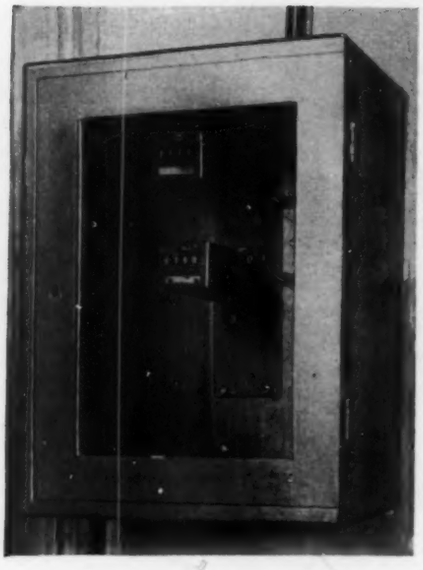
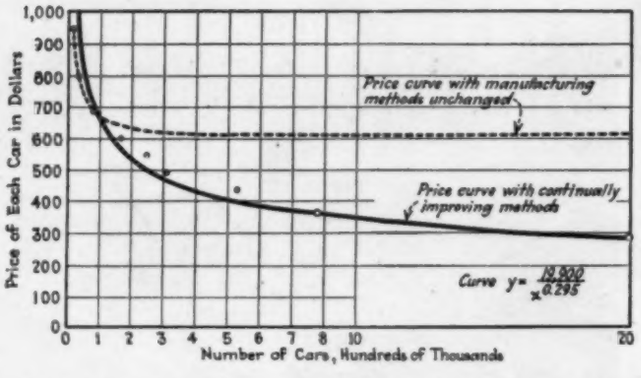


Fig. 8 — The electric contact shown in Fig. 4 actuates this production counter. The upper register records output on the shift, and the lower register output for the week

Fig. 9—To measure the rate of flow of production, this recording chart is used. It is actuated by the electric contact shown in Fig. 4, and runs by clockwork. A mark is made each time a packed vacuum cleaner goes over the conveyor

Fig. 10—In studying the relationship of output and prices of vacuum cleaners under existing manufacturing methods and under forecast improvements, similar Ford Motor Company statistics were found useful when plotted in a graph



tion of the process of increasing the rate of output by improving production operation. The methods employed in the study are based on experience gathered not only from the Siemens plant but also from outside sources.

The data supplied in Henry Ford's book, "My Life and Work," regarding production and prices of his car up to 1917 have been closely studied. It has been found that the curve traced by plotting the number of cars on the x-axis of a chart against the price on the y-axis, as shown in Fig. 10, is that of the exponential hyperbola $y = \frac{19,900}{x^{0.295}}$. The exponent 0.295 represents the acceleration factor based on the assumption of continuity in efforts to accelerate production. Otherwise the hyperbola would run into a straight line parallel with the x-axis, and might lead to error.

The figures for this equation differ, of course, for every manufacturing industry, but a certain similarity exists. By evolving an equation fitting the vacuum cleaner production of the Siemens works the problem of prices in relation to quantities, based upon the assumption of constant efforts toward facilitation of the work, has been reduced to a mathematical function. This function has been checked and found to tally very closely with actual developments. The results of such investigations are of definite value in studying the industry and keeping it on a sound financial basis.

Measuring Internal Threads

DIFFICULTIES in making accurate measurements of internal threads are well known. The method of making a mold of part of the internal thread by pouring a mixture of molten sulphur and graphite into it, and later examining the external thread thus obtained by means of a shadowgraph, although often used, does not give very reliable results, according to an article by A. Haertel, in the June issue of *Zeitschrift fuer Instrumentkunde*. This inaccuracy is due to the unknown deformations produced by setting of the mixture, which has a coefficient of thermal expansion quite different from that of steel.

A simple and accurate device for measuring internal threads which has been used for measuring threads ranging from $\frac{7}{16}$ in. Whitworth to M27x20 fine metric thread, uses a copper amalgram for the plastic material. The range of 159 threads required only six sets of adjustable gages of diameters of 8, 10, 12, 15, 18, and 21 mm. The copper amalgram is a plastic material which solidifies in about eight hours, and has a shrinkage of about one-thousandth of a millimeter. Each mold is taken of two opposite, parallel, 60-deg. sections of the internal thread, so that three repeated double-molds permit the gaging of the whole of the interior of the nut with great accuracy.

The gage itself is composed of three main parts, assembled by two locating pins and two cap screws. It is entered into the nut assembled. Four long, thin, sideplates, with threads corresponding to the inside thread of the nut, prevent side spreading of the plastic material. These sideplates are the only parts which are changed in measuring different threads within a considerable range of sizes. Two slightly tapered wedges are used for centering purposes.

The smallest internal thread measured below 8.5 mm. in diameter was the metric thread M5. The smaller gages are individual and cannot be used outside a certain range of sizes.

OIL *and* GREASE

When and Where Each Should Be Used

Type of bearing, its speed, load, and temperature are among factors controlling selection

By P. F. CASSIDY

Engineer, Sales Engineering & Service Dept., Tide Water Oil Company

In some applications oil provides better lubrication than grease, but under other circumstances the reverse is true. Best results depend upon suiting the lubricant to the particular operating conditions. This article tells how satisfactory results have been attained in many industries and gives the major specifications for several lubricants

ALTHOUGH the proper lubrication of industrial machinery is usually an important factor in determining the cost of upkeep and frequently has a direct effect upon production schedules, such lubrication too often is entrusted to persons who know almost nothing about the kind of lubricant needed or the best method of applying it. To make a correct recommendation as to the proper lubricant for any particular purpose requires a thorough study of the operating conditions, the mechanical details involved, and the adaptability of the lubricant to these conditions and details.

Under certain conditions an oil works to better advantage than grease, and vice versa, depending upon local conditions, type, design, temperature, and speed of the bearing.

Bearings are subjected to wide differences in operating conditions. As an example, speeds from 25,000 to 30,000 r.p.m. are not at all uncommon in textile mills, while speeds of 3 to 20 r.p.m., with pressures varying from 3 to 5,000 lb. per sq.in., and temperatures ranging from 5 to 300 deg. F., are the usual conditions found in cement and sugar mills.

Under these circumstances it is difficult to lay down any all-inclusive rules to govern the correct selection of the lubricant or the best method of applying, but some illustrations of good practice may aid in bringing about a better appreciation of the results which have been attained through close co-operation between specialists in lubrication and industrial concerns when both have sought an answer to the problems presented in the equipment they use or manufacture.

In machine shops the first problem usually is to make arrangements whereby bearings will be lubricated at regular intervals. To select oil or grease of the right quality is not difficult, but to ensure its application as it is needed is quite another matter. One of the chief sources of lubrication trouble in the machine shop results from the lack of a regular lubrication schedule or from the carelessness or poor judgment of the individual whose duty it is to keep bearings lubricated.

Line shafting, especially where placed overhead, is likely to be a source of annoyance and delay unless simple means are taken to keep the bearings lubricated. If these are of the plain type, and if speeds, loads, and other conditions are not abnormal, a medium machine oil having about the following specifications usually gives satisfactory results: Viscosity, Saybolt Universal, at 100 deg. F., 175 to 300 seconds; flash point, 380 deg. F.; fire, 430 deg. Fahrenheit.

With other conditions the same, but with speeds exceeding 1,000 r.p.m., light machine oil of about the following specifications may be substituted: Viscosity, Saybolt Universal, at 100 deg. F., 150 seconds; flash point, 365 deg. F.; fire, 415 deg. F. Unless some method of applying the oil regularly in proper amount is worked out, however, trouble is almost sure to result. It is human nature for the workman usually assigned to do the job to overlook or slight some bearings, and perhaps over-oil others.

One simple and usually satisfactory method of meeting this situation is to employ ordinary bottle oilers. These comprise a glass bulb or bottle inverted over the oil hole, and a rod projecting from the interior of the bulb through a gland in the neck and into the oil hole. The lower end of the rod rides on the shaft which imparts to it just enough motion to cause oil to feed slowly down the rod and into the bearing. When the shaft stops the oil feed ceases. A distinct advantage of these oilers is that the foreman, or whoever is to supervise oiling, can see at once, without climbing a ladder, which bearings have a supply of oil and which are nearly dry. In other words, he has a visual check on the workman charged with the duty of oiling and so usually can forestall the trouble which results when a bearing runs dry.

In low-speed plain bearings for line shafts and in other plain bearings running at higher speeds, where oil throwing may be a cause of trouble or annoyance, grease

often is used with excellent satisfaction, especially if proper means are employed to force it into the bearing and to renew it as required. Care must be used, however, to employ a grease of good quality and of a consistency suited to the temperature and other service conditions involved. Greases containing non-lubricating substances—sometimes added to increase body—are not suited for bearing lubrication.

Generally speaking, the lubricating qualities of a grease are dependent chiefly upon the lubricating oil it contains. The non-fluid content merely acts as a sponge or vehicle for the mineral oil, and serves primarily to keep the oil in the bearing.

Not many years ago the use of oil in ball bearings was seldom recommended, usually because, if the housing was too tight and an excess of oil was added, the bearing might run hot, especially when the oil was too viscous. This led to recommending grease which gave, and still gives, satisfaction where the the correct quality and quantity is employed.

Table I—Oils Recommended for Well-Enclosed Ball Bearings

Speed in R.P.M.	Kind of Oil	Viscosity Saybolt Sec. at 100 Deg. F.	Flash Deg. F.	Fire Deg. F.
25,000 to 30,000	Light spindle	60 to 75	330	380
1,100 to 3,600	Light bearing	125 to 175	360	410
500 to 1,000	Medium	260 to 275	410	465
Under 500.....	Heavy	450 to 500	425	485

It has been found, however, that poor grease which cakes, or carbonizes, or contains non-lubricating fillers, will not give satisfactory results. Other difficulties often may be encountered when the modern high pressure gun is employed in such a way as to fill the ball bearing completely with grease. If the construction is such that the grease cannot work out, heating occurs.

Partly for these reasons some makers of ball bearings now recommend oil for lubrication, especially where the housing is sufficiently well enclosed to prevent the oil from splashing out. Only very little oil is required and non-lubricating substances are not forced into the bearing if a clean oil is used.

Excellent results in ball bearings used under average conditions are attained by using an oil having approximately the characteristics shown in Table I.

For roller bearings, grease usually is recommended, partly because the speed in general is less than for ball bearings, and partly because grease can be kept in without causing overheating. Also, if an excess of grease is applied it will work out of the bearing more readily than in the ball type. As in all cases where grease is employed, its melting point in relation to the temperature under which operation takes place must be considered.

Greases for lubrication of roller bearings which meet the major specifications given in Table II and are used under the conditions indicated, give excellent results.

For bearings which are used where high temperatures prevail, it is necessary, of course, to employ a grease of high melting point, preferably compounded from high-flash cylinder stock and tallow. Graphite of the best grade often is added to grease bearings which run at temperatures above 400 deg. Fahrenheit.

In average plain bearings for machine tools, entirely satisfactory results are secured with a medium machine oil having a viscosity of 185 to 230 sec. Saybolt at 100 deg. F., a flash test of 390 deg., and a fire test of 445 deg. F. Where speeds exceed 500 r.p.m., however, it is usual to recommend an oil of 185 sec. Saybolt viscosity at 100 deg. F., 390 deg. F. flash, and 445 deg. F. fire test.

If, on the other hand, proper provision has been made for grease lubrication, excellent results can be secured, providing that a good grade of grease is used at proper intervals and that the new grease reaches the surface to be lubricated. The construction and application should be such that spent grease is forced out completely by the new grease which enters.

In such applications, if the temperature does not exceed 150 deg. F., greases which meet the following specifications are satisfactory for the screw down or spring type grease cup and for the pressure gun: Melting point, 190 deg. F.; A.S.T.M. Consistency, unworked, 270/300; A.S.T.M. Consistency, worked, 370 maximum.

In general, open machine shop gears, running at moderate speed in an oil bath, can be lubricated effectively with an oil of 130 to 150 sec. Saybolt viscosity at 210 deg., and with flash and fire tests of 525 and 600 deg. F., respectively. Such an oil adheres satisfactorily to the gear teeth, providing the speed is not excessive. Ordinarily, gears that run at a speed too high for this oil are enclosed.

To lubricate enclosed machine tool gears, steel on steel, a bath of compounded gear oil having a viscosity of 150 to 165 at 210 deg. F. and testing 540 deg. flash, and 625 deg. F. fire gives excellent results. Where the gears are steel on bronze, a mineral oil compounded with castor oil having 135 to 150 sec. Saybolt viscosity at 210 deg. F., 540 deg. F. flash, and 625 deg. F. fire test is equally satisfactory. In these cases, the same oil serves for the gear shaft bearings if the design is such as to provide oil for both gears and bearings from the same bath.

While the foregoing outline relates primarily to machine shop practice, the same principles and lubricants obviously can be applied to other industrial equipment operated under the same or similar conditions. Where heavier loads and higher or lower speeds and tempera-

The Fifth Product Engineering Number

Next week the fifth, and last, Product Engineering Number of *American Machinist* will be published. In that number there will be an announcement of the plan for carrying on this activity as a separate publication after the first of the new year.

tures are encountered, however, the lubricant often must be changed accordingly, as the following paragraphs indicate.

In the power plant, high speed turbines, reduction geared turbines, and ring bearing type electric motors all are lubricated with oil. Motor bearings of the ball bearing variety require a study of the specific type and the temperature of operation. If they have a tendency to throw or splash oil out, a medium bodied grease should be used. If the temperature conditions are severe, it will be found necessary to use a semi-fluid grease with ability to withstand high temperatures.

A study of boiler plant equipment from a lubrication angle necessitates consideration of the different designs and kinds of stokers in use.

Steam boiler feed pumps, and vertical steam engines driving certain kinds of stokers, require cylinder oil lubrication for the steam cylinders, as well as machine or motor bearing oil for the bearings. Steam turbine driven boiler feed pumps and steam turbine driven stokers require a high grade oil for the lubrication of the turbine bearings. Stoker reduction gears can be lubricated with a high viscosity cylinder oil or a special gear grease. Bearings on most stokers are equipped for grease lubrication. A medium bodied grease of high melting point will work to better advantage on these bearings because of the high temperatures encountered.

Selection of grease depends upon particular temperature, pressure, and other operating conditions. It is not advisable to set a standard specification without a careful study of the controlling factors.

There are several methods of applying grease to bearings, such as compression grease cups, pin type cups, and pressure guns. The first two require a grease of lighter consistency than the pressure gun, as operating heat is more or less depended on to regulate the flow, or forcing, of the grease into the bearing or journal. The pressure gun, being capable of developing extremely high pressures, can handle greases of heavier consistencies and higher melting points, which must be forced into clearance spaces in direct contact with the journal. With pressure guns, all that is necessary is to continue forcing the lubricant through until fresh grease appears at the bearing end. This is a sign that the clearance space has been freed of the old lubricant and, perhaps, deteriorated grease, dust, dirt, or gummy impurities.

In the woodworking industry considerable improvement has been made in lubricating methods, because the industry has sought to lower the cost of lubrication, to increase production, and to reduce fire and accident hazards to a minimum. A large percentage of the lumber, saw, and planing mills have replaced old plain type bearings with ball bearings. These bearings are designed for oil and grease lubrication. Which is used depends upon the construction of the housing. If it is a leaky housing, grease must be employed. If the housing is tight and will retain a light-bodied lubricant, oil is used. In planing mills, speeds are high and oil works to better advantage than grease, whereas, in lumber and saw mills, large bearings are used and speeds are low. Hence grease is the more efficient and the more satisfactory lubricant.

In the wool, worsted, cotton and silk mills, there are a large number of high-speed machines, such as spinning frames and drawing frames, where a light oil is more satisfactory than grease, but in the circular comb and card boxes, a liquid grease works to better advantage, the tendency for grease to throw being less than oil.

Oil is used entirely for cylinder and bearing lubrication in the vertical type of refrigerating machines. On horizontal machines oil is also used, but if they are of the Corliss type, grease is found to be more satisfactory in the rocker arms and eccentric rod.

High speed steam engines direct connected to generators require oil for cylinder as well as bearing lubrication. The governor, if a flywheel type, requires a grease of light consistency. For the eccentric rods and rocker arms, a grease is found to work better than an oil, due to the oscillating movement of these parts. The above recommendations apply also to uniflow engines.

In paper mills, bearings on a large number of older type drier rolls are equipped for grease lubrication. High melting point grease of the proper consistency usually is recommended after a thorough study of existing conditions, taking into consideration the temperature, speed and pressure on the rolls. Calender roll bearings require a high viscosity, high grade mineral oil. Beater bearings are equipped in some instances for grease, and in other cases for oil. Where a grease is required a high melting point product should be used. If oil is employed, a high viscosity, straight mineral oil is recommended.

In cement mills on large kiln and grinder bearings, it is essential to use a high melting point grease, as oil will not give efficient lubrication under the extremely high temperatures encountered on bearings of this type of machinery.

Roll neck bearings in steel mills must be lubricated with a high melting point grease manufactured so that it will withstand the washing action of water which may be used to cool such bearings. Large open gears used in steel mills, also found in cement and paper mills, require a gear grease of a nature that will readily adhere to the gears and not fly off. It must also be able to stand the high temperatures encountered in these mills.

With the exception of their electric motor bearings some types of electric cranes are equipped entirely for grease lubrication. They may be equipped with a central pressure system whereby all the bearings can be lubricated simultaneously. Other types of electric cranes are equipped for oil lubrication, with the exception of the gear boxes, where grease is used on the gears.

Table II—Specifications for Grease Suited for Use in Roller Bearings

Grease	Type	Melting Point By Mercury Bath	Consistency A.S.T.M.	Recommended for
No. 3 Cup...	Medium (made with light oil)	200 Deg. F.	220/240 unworked 350 max. worked	Small roller bearings with little or no end thrust.
No. 3 Cup...	Medium (made with viscous oil)	200 Deg. F.	225/245 unworked 355 max. worked	All sizes of roller bearings.
Fibre Grease.	(Made with viscous oil)	300 Deg. F.	Not measured on this type of grease	Use in place of Cup Grease No. 3 when bearings are exposed to high room temperatures.

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions given at the foot of the page have been prepared

THE · FOREMAN'S R

Advising Employees About Their Affairs

"HELLO, Al. What's this I hear about you firing Roy Kirkland, and Williams sending him back to you?" questioned Ed as the two met on the way home. "Can't we fire a man we don't want any more?"

"You ought to know Williams better than that, Ed. He merely suggested that I give Roy another chance."

"Sure, but it was as good as an order, wasn't it? What right has he to interfere in your department? You've often said that was the one thing you wouldn't stand for."

"I'm mighty glad he did interfere in this case. He saved me one of my good men."

"Yes, I know Roy used to be, but someone told me he had been slipping lately. Is that so?"

"Yes, it's true. I lost patience with him yesterday when he spoiled a large piston, and sent him to the office for his money. He met Williams on the way over, and Williams wanted to know what was the matter with him lately. Roy told him that he was worried about an automobile accident he had been in."

"Yes, but what has that got to do with his work? He wasn't hurt was he?"

"Don't interrupt so often, and I'll try to tell you. It seems that Roy had a collision, and the owner of the other car is threatening to sue unless Roy settles. Roy claims it was all the other fellow's fault, and he has been worrying so that it has seriously affected his work."

"But he was working for you wasn't he? Why should Williams go over your head? That's what I want to know."

"He didn't go over my head. He called me up and asked me if I would put Roy back to work."

"But how did that make Roy any better?"

"Williams told him that he would have the company attorney look into his case, and Roy is working like a house on fire. A man can only have one thing on his mind at a time. He can't defend lawsuits, or fight with his wife, and run a machine at the same time. Roy is running a lathe now."

"But Al, I don't think that a man's private affairs are any of the company's business."

"Maybe they're not, but when his private affairs affect his work, it is the company's business. It must choose between losing the man, or helping him, and Williams prefers to help."

How far is a company justified in advising its employees? Is paternalism objectionable when it is impersonal? If the company expects its employees to take a personal interest in its operations, must it not reciprocate by taking an interest in employees' affairs?

Idea suggested by W. J. Owens, Foreman, Newport Rolling Mill Company

All foremen are urged to discuss these questions vital to their work; of course the

DISCUSSION OF EARLIER TOPICS

Should the Workman Share Responsibility?

I BELIEVE that Ed showed a deplorable lack of understanding of the mental processes occasionally found in good workmen. Anyone who has had reasonable experience in handling workmen knows that there are certain good workmen who are so upset when they fall down on the job, that they will say most anything in a foolish attempt to "ride through" their error.

Perhaps this is the reason why they still are only workmen, though on the average they are the best in the shop. When Ed lost control of himself and descended to the workman's plane and ended by firing him, Ed was "talking big" in his own way.

That the workman was wrong in spoiling the job is partially true, but at least, by Ed's own admission, there were extenuating circumstances. The worker probably knew in his own heart that he was wrong, but he was so surprised at his own error, that when Ed jumped him for it, he blundered into a defense which he probably never would carry out in actual practice.

—C. V. BROWN, *Foreman, Acme Stamping Company.*

*

Buying or Making Special Tools

THE question of whether to buy certain tools and small parts from concerns specializing in such things, or to make them ourselves, has been settled in our plant by sending for quotations to all concerns able to make such parts. We have a nicely equipped factory capable of making all kinds of turret work, such as screws, studs, binding posts, and similar parts. We have plenty of drill presses and tapping machines, yet we find that we cannot make small turned brass parts as cheaply as we are able to purchase them. We buy from specifications with the privilege of rejection or replacement if the parts are not to the print.

—CHARLES H. WILLEY, *Asst. Plant Supt., Hoyt Electrical Works.*

I AGREE with Al that the proper move is to buy standard tools from specialists, rather than to make them oneself. In the first place the manufacturer can introduce those little refinements of material, heat treatment, and manufacturing processes that are beyond the practical scope of the shop making only a few. These refinements make a worth-while improvement in the functioning and life of the ultimate product. The specialty manufacturer of standard tools is in active competition with other manufacturers of the same product, so that he has a constant incentive to improve his product and to cut his costs to meet this competition. Manufacturing on a mass production basis, with every opportunity to regulate employment by stocking these standard parts, the specialty manufacturer can produce and sell at a lower cost than that at which the user can manufacture.

—CHARLES H. KIRKBRIDE, JR., *Asst. Chief Draftsman, U. S. Naval Aircraft Factory.*

I HAVE frequently had an opportunity to make a decision as to whether we should make certain tools or buy them, and have had many arguments "pro and con."

Tom Black was distressed because he believed that the tools in question were special, and not standard, as Williams had stated they were. There is the same difference between standard and special tools as there is between mass production and contract work. It follows that the shop which produces tools on a mass production basis can do the work cheaper. Where development and experimental work are involved, it is usually cheaper for a shop to make tools and equipment for its own special needs than to buy them.

—JACK SARGENT, *Foreman, R. Wallace & Sons Mfg. Company.*

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When Do Automatics Pay?

ED IS certainly wrong in approaching Williams with a request for an automatic without having additional figures to back up his request. There are many factors to be considered beside the obvious one of increased output per hour. Depreciation, interest on investment, and upkeep are some of them. A vital point is whether the machine can be kept operating steadily and continuously enough to make it a paying proposition. If we need only, say, 50,000 pieces in a given period, then such factors as interest on capital would be double what it would be if we could use 100,000 pieces in the same time. Ed should have something definite and explicit on the savings to be made by the machine, rather than a vague idea that it ought to be a good thing, and also be reasonably sure that others will be required before requesting its purchase.

—H. GREENHALF, *Walkerville, Ont., Canada.*

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Games at the Noon Hour

THERE is nothing that benefits the employee more than a little diversion, such as a game of baseball, tennis, or handball during the noon-hour period. But he must not put too much effort into the sport, or the reaction from this exertion will cause him to drop below his average efficiency during the afternoon period. I work for a large industrial concern which sees that ideas along these lines are carried through in a successful manner. It is the policy to encourage employees to engage in some sort of game during the noon hour. This diversion

discussion is not limited to foremen. Letters accepted and published will be paid for

takes their minds off their work and refreshes them, so that when they return to their work they are often able to solve problems which had bothered them before lunch.

A large field has been laid out with four indoor baseball diamonds. An indoor baseball league has been formed, comprising one or more teams from each department, and every noon hour there are four games in progress, with hundreds of spectators watching. A large space has also been laid out nearby, where the game of horse-shoes can be engaged in. This part of the grounds is always filled with players. At the back of the plant there are several tennis courts that always attract a number of players and spectators during the lunch-hour period. In the restaurant, a portion of the space at one end is reserved for card tables and there are just as many onlookers as there are players.

—FREDERIC A. J. SCHMIDT, *Industrial Engineer, Western Electric Company, Kearny.*

*

Tempering General Purpose Tools

I BELIEVE that certain tools need more personal attention than the average heat-treating department will give them, although such a department can give them this personal attention if it is so minded. The real difficulty lies in the mental attitude which assumes that the transition from all-personal attention to full-automatic controls and specifications eliminates the need for any personal and detail check up on the job. No automatic contrivance is ever really 100 per cent perfect, and an occasional checkup, particularly when something new or different is undertaken, is both worth while and essential.

Automatic controls and specifications are probably the greatest single factor entering into successful tool work. But, just because the records show that everything has been done in accordance with the prescribed routine, it should not be taken for granted that the work must be right.

—JOHN F. HARDECKER, *Chief Draftsman, Naval Aircraft Factory.*

ONE of the most skillful hardeners I have ever met was an old German blacksmith in the employ of a mid-western manufacturing plant. His "heat-treating plant" consisted of an open forge fire and several tubs of oil and water. With this antique outfit, he handled a wide variety of hardening jobs remarkably well. A man less skilled would have ruined many an expensive tool.

Skill has always played an important part in hardening and tempering tools, and probably always will, regardless of the equipment. To handle modern equipment skillfully, however, requires a different type of man than did the manipulation of the old forge fire. The old timer generally held held the "book mechanic" in contempt, but modern equipment, requires a mechanic who has a good background of general training and wide experience.

—CARL E. SCHIMMAN, *Production Engineer, Apex Production Company.*

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Should Workers Buy Company Stock?

THE essential requirements in all industrial activity are faith in what is being done and co-operation with one's fellows. These are demonstrated by the workman who voluntarily purchases a share in his employer's business.

Every employer desires workers who are loyal, and he wants to see them prosper and build for the future. Such share ownership for the workman will react favorably to this end. By investing, he benefits himself, benefits his corporate employer, and improves the atmosphere of the shop. It is from such workers that employers are created, as well as good citizens.

Such a man stands a much better chance of promotion than the indifferent workman who spends his all and loiters mentally in the shop and after hours. Furthermore, he creates a saving fund, and if the business is very successful, as many are, he may reap a conspicuous profit from the appreciation of the shares he owns, and benefit his social and material well-being.

—HOMER A. HERR, *General Manager, Automatic Centrifugal Company.*

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THE · NEXT · TOPIC

"Eating During Working Hours"

Should Workers Buy Company Stock?

SUMMARY OF THE DISCUSSION

The company was about to expand, and Williams had a plan whereby the employees would be allowed to subscribe for one or more shares of stock, paying for it in installments.

Ed stated that the men would resent any plan that took money out of their pay envelopes, while Al believed the plan would be well received.

THE discussion favored employee ownership of company stock. The benefits to be derived from such a course were thought to be mutual. The fact that a substantial percentage of the stock of some of the large companies is owned by its employees was pointed out as proof that the results of such a policy are beneficial. An executive stated that it is from investing employees that future employers will come. Another pointed out that its influence is to stabilize employment, eliminate or lessen labor trouble, and promote more economical operation.

That such expectations are too optimistic was held by some who contended that stock ownership becomes impersonal after the novelty has worn off. Different methods were advocated for putting the plan into effect, but it was agreed that any introduction to the plan must be educational and that the whole transaction must be handled as a voluntary business transaction, initiated by the employee. One contributor was of the opinion that employees should not be encouraged to buy other than an investment interest, such as preferred stock, or bonds.

Cutting Costs on Long Push-Rods

A method which eliminates dividing a long cut into several subsidiary operations and saves much time both in feeding and in machining

ECONOMICAL production of exceptionally long pieces from bar stock has been a bothersome problem in the metal working industries. Several serious drawbacks, such as low production, high percentage of idle machine time, and excessive waste of stock, have made pieces of more than ordinary length relatively expensive parts to produce.

Until recently, such pieces, usually with squared up or formed ends held to limits, were made in hand operated machines. The stock stop was held in the turret, and the cross-slide forming and cutting-off tools were brought to position by a hand lever. The desired length of bar was fed to the stock stop in the usual manner by successive movements of feeding fingers, or by a roller feed mechanism in place of the fingers.

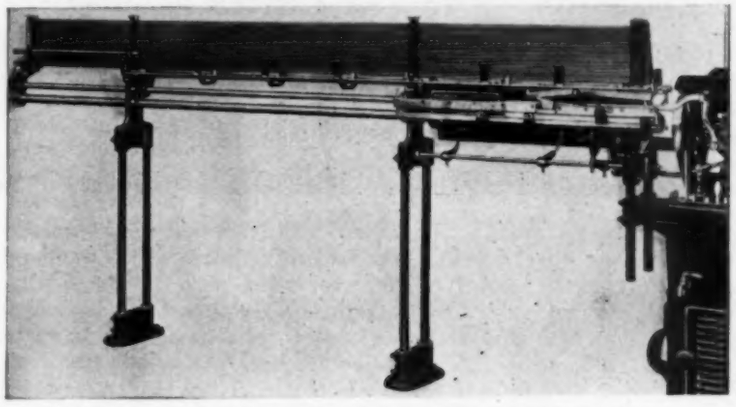


Fig. 1—Automatic rod magazine that keeps the roller feed of the machine supplied with stock

This was the method used by a well known manufacturer of automobiles, in making push rods 11$\frac{13}{64}$ in. long by $\frac{1}{4}$ in. in diameter, of cold rolled steel, for the valve lifting mechanism of the engine. Then the equipment described in the following paragraphs was installed. Engineers of the Brown & Sharpe Manufacturing Company, of Providence, R. I., after study of the problem, designed a mechanism which has greatly increased the production of the push rods. The complete unit consists of a Brown & Sharpe No. 00 Automatic Cutting-Off Machine, an automatic rod magazine, and a special rolled feed mechanism with special stock stops.

By using an automatic cutting-off machine in place of a wire feed machine, it was found that there was a slight saving in cutting time. The real gain, however, was obtained by equipping the machine with the rod magazine shown in Fig. 1, and with a means of feeding the stock to the clutch by rollers, as Fig. 2 shows.

The Automatic rod magazine handles rods 12 ft. in length. One rod provides only twelve pieces. In restocking the hand operated machine, it was necessary for the operator to place each rod in the wire stand by hand and also insert it in the feed tube. Thus, it may be seen that a substantial saving in time is secured by using the device for feeding the stock automatically without any appreciable loss of time between two rods. The automatic rod magazine is so designed that, when the last end of the rod being fed has passed through the feeding mechanism, an automatic trip stops the machine, except the spindle, and sets the magazine in operation so that a new rod is presented to the roller feed soon after the end of its predecessor has passed through. In this way, the second rod acts as a pusher for the first, feeding it through the spindle, and, finally, ejecting the unused end.

In addition to this, the use of the roller feed *A*, Fig. 2, enables the rod to be carried to the stop very rapidly in a single movement. A lineal feed of 25 in. per second affords a substantial reduction in the time consumed in feeding. In fact, it reduces a period in the production cycle of the piece, ordinarily greater than the cutting time, to less than half of it. The feed rollers are driven from the driving shaft of the machine through reduction gearing.

The machine is equipped with two stock stops, *B* and *C*, Fig. 2. Stop *C*, on the tool slide determines the correct length of the piece, and the other, *B*, is an auxiliary stop of the swinging type, which operates only once to each rod, to gage the position for trimming the first end of each new rod. Both stops are adjustable.

The first of these stops, *C*, operates in the same manner as the regular stock stop on any B. & S. automatic machine. As the piece being made is of exceptional length, an adjustable guide is provided to assure the stock being centered correctly on the stop before the tools are advanced.

The second stop is the regular swing stop of the machine, equipped with a timing device which prevents the stock stop from operating more than once every twelve pieces, or once for each new rod. This is shown in Fig. 3, while Fig. 4 shows the details.

The swing stop *B*, Fig. 3, of the standard machine, functions once for each piece, and is operated through levers from a cam on the chuck cam shaft. This has been changed on the B. & S. machine by adding a stop release cam and lever which locks the stop in the "up"

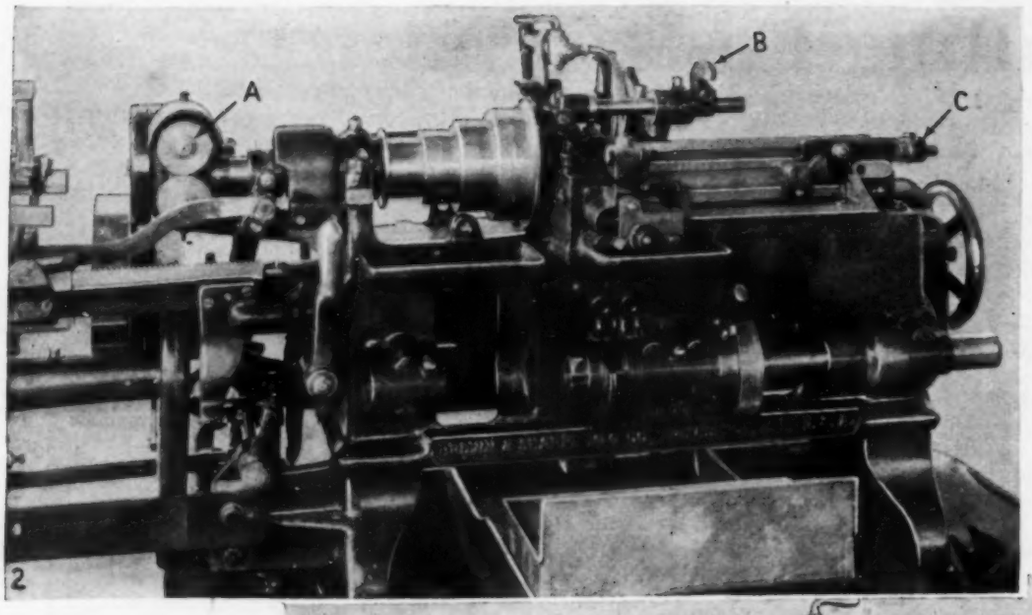
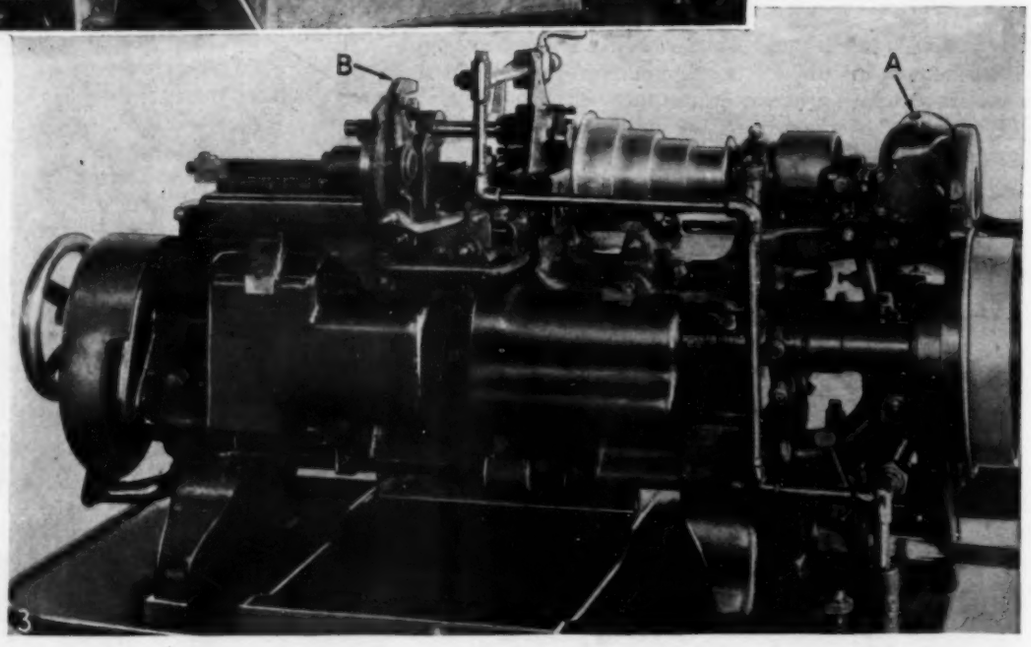


Fig. 2 — Front of machine showing roller feed and stock stops

Fig. 3—Rear view of machine with ratchet pawl, swinging stock stops, and other part shown



position and releases it only when tripped by the special timing mechanism shown in Fig. 4. In this way, the stop swings into position only once every twelve pieces. When released, the stop operates in the usual manner, stopping the new rod in position for trimming, and then being locked again until the next release of the timing mechanism.

The timing arrangement consists of a 36-tooth, circular ratchet *A*, Fig. 4, which is advanced, one tooth for each piece cut off, by a pawl *B* that receives its motion through a pivoted arm from each forward movement of the rear cross slide. Three trip dogs *C* are carried on the ratchet, and are equally spaced with twelve teeth between each, thus providing for a trip of the release lever *D* every twelve advances of the cross slide.

The swing stop *E* is constructed to be adjustable longitudinally; and it can also be retimed, by rearranging the trip dogs and adjusting screws, to accommodate a number of different sized pieces. The number of trip dogs can be varied, and other ratchets, having more or less teeth, can be used for jobs not falling within the limits of the above equipment.

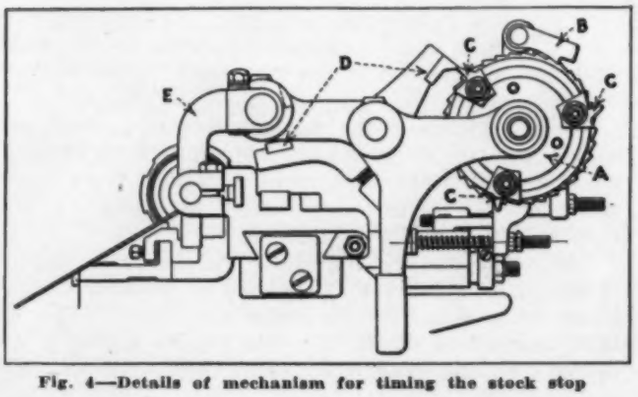


Fig. 4—Details of mechanism for timing the stock stop

This type of stock stop is particularly advantageous in that it automatically compensates for irregular lengths of the rods. It also reduces spoilage by stopping the rod in such a position that a short piece is cut from the front end of each rod, thereby preventing damaged rod ends from being included in the finished piece. Two grooved disks, held together by helical springs, feed the rod forward until it strikes a stop. When this occurs, the disks spread and slip. This permits of high speed, and does not require accurate feeding.

The entire arrangement is more or less flexible, and may be adapted to other jobs which vary in size and detail from the piece described. Turret, forming, and even screw machines with reversing spindles, can be fitted with similar equipment for performing such operations as drilling, chamfering, threading, tapping, and knurling.

ABSTRACTS OF A.S.M.E. PAPERS

The following are abstracts of some of the papers presented at the Fiftieth Annual Meeting of the American Society of Mechanical Engineers, Engineering Societies Building, New York, December 2 to 6

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Turning with Shallow Cuts at High Speeds

By H. J. French and T. G. Digges

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MOST studies of turning have been made with relatively coarse feeds and deep cuts. It is now possible to predict, with an accuracy sufficient for many practical purposes, the cutting speeds which can be used economically in the rough turning of metals. Comparable information is not yet available for the shallow cuts used in finish turning.

The experiments described in this report relate primarily to a new method of test for lathe tools taking shallow cuts. It was first used in a study of the effects of feed, depth, cutting liquids, and tool form upon the cutting speed to give a broad background for useful interpretation of results. The new test was then used in a study of the effect of composition and heat-treatment upon the performance of carbon- and high-speed-steel tools and the results compared with those obtained in the customary rough-turning tests.

While recently there has been a tendency in machine-shop practice to replace finish turning by grinding, the discussion of a recent paper relating to the rough turning of alloy steels indicated active industrial interest in test methods applicable to turning tools working at high speeds with shallow cuts and fine feeds. This is perhaps natural, since the bulk of industrial machining does not involve cutting conditions as severe as those obtaining in the usual rough-turning tests of high-speed tool steels.

From three to six tools were tested after each of two grindings for each condition investigated, and the tests were all made in sequence. For example, in the study of the effect of cutting speed on tool performance, one tool was tested at each of the selected speeds in the series, then a second tool was tested at each of the different speeds, and this procedure repeated until the desired number of tools had been tested for each condition. Only average values were used in the comparisons made throughout this report.

The results and conclusions are as follows:

1. The method described is based upon the fact that when two tools are set at equal depths in one toolholder the second or "trailing" tool will not cut so long as the "leader" or cutting tool shows no wear. With the carbon- and high-speed-steel tools used, the second tool began to cut when the leader had worn 0.001 to 0.002 in., and at this point the leader or test tool was considered to have failed. All subsequent comments on turning with shallow cuts and fine feeds are based on this end point, but greater wear can be made to represent tool failure by using a shallower setting for the second tool than is used for the cutting tool.

2. Tests were made dry at different cutting speeds, feeds, and depths of cut on nickel-steel forgings with tensile strengths of 80,000 to 100,000 lb. per sq.in. to give a broad background for the interpretation of the results of tests of different tool steels, first heat-treated in various ways. The results could be represented approximately by the following equations in which V is the cutting speed, T the tool life, F the feed, D the depth of cut, A the area of cut ($= DF$), and c, K, K_1, K_2, and n are constants.

For high-speed-steel tools,

$$VT^{1/10} = c \quad [1]$$

$$V = K_1 - K_2(DF) = K_1 - K_2A \quad [2]$$

For carbon-steel tools,

$$V = \frac{K}{DF} = \frac{K}{A} \quad [3]$$

These equations are not to be construed to represent the true laws of cutting, since the cutting speed is probably not affected equally by variations in the feed and the depth of cut. However, they represent approximately the results of the experiments made with depths of cut of 0.005 to 0.020 in. and feeds of 0.0115 to 0.0204 in. per revolution.

3. In tests of short duration, where tool failure occurred in about 2 to 10 min., the tool life was increased somewhat more by the use of water than by lard oil, but in tests of about 50 min. duration, under the same feed and depth of cut but lower cutting speeds, these two liquids produced effects of the same magnitude. The increases in tool life from the use of these liquids were not large in any case, but the finish on the work piece at the end of the cut was better with the liquids.

4. Tests with tools of different forms and angles showed that the successful application of the described method of test was not dependent upon having the broad-nose tool used in a majority of the experiments. Tools with a plan angle of 65 deg. had a longer life than the break-nose tools, but the finish produced on the nickel steels in dry turning did not appear to be as good. The best tool life in the broad-nose tools was obtained with a back slope of 30 deg.; a side slope of 0 deg. was better than one of 8 degrees.

5. The cutting speed of quenched carbon-steel tools

was not affected appreciably by variations in carbon content from 0.75 per cent to 1.3 per cent nor by subsequent tempering at temperatures up to 375 deg. F., which did not lower the hardness; the cutting speed of the carbon-steel tools was equal approximately to that of a quenched "oil-hardening" tool steel, and only slightly lower than the cutting speed of a steel containing 1.3 per cent carbon and 2¾ per cent tungsten.

6. The cutting speed of carbon-steel tools was lower in all cases than that of high-speed-steel tools, but the differences between the two decreased with decrease in the areas of cut in dry turning.

7. The heat-treatments which resulted in the best roughingtool performance for high-speed steels of customary compositions also resulted in superior performance under shallow cuts and fine feeds. These treatments comprised oil quenching from the highest practical temperatures, followed by tempering to convert the larger part of the retained austenite in the steel to martensite.

Cobalt Only Has Beneficial Results

8. Of twelve elements added in different proportions to chromium-tungsten or chromium-tungsten-vanadium high-speed steels, only one, cobalt, produced decidedly beneficial results. Molybdenum and nickel offered promise under certain conditions, while the remainder either had a negligible effect or were definitely deleterious from one point of view or another.

9. Cobalt improved the performance of the high-speed-steel tools both under shallow cuts and under heavy duty, but the maximum benefits were obtained only with high hardening temperatures. The percentage gain from the addition of cobalt was somewhat greater in roughturning than with shallow cuts and fine feeds, but increase in cobalt above about 5 per cent did not produce improvements commensurate with those resulting from 3.5 to 5 per cent increases in cobalt content and high hardening temperatures.

10. Replacement of part or all of the tungsten in high-speed steels by molybdenum, in the ratio of 1 part molybdenum to 2½ parts of tungsten, produced steels having performance comparable to that of the tungsten steels. Such substitution should be useful in case of a depleted tungsten supply, but is not advocated at the present time since there was some evidence of irregular performance in the high-molybdenum steels and their hot-working properties did not seem to be as good as those of the tungsten steels. However, a steel with 7 per cent molybdenum and no tungsten had one advantage over the tungsten steels for roughing tools in that its hardness and performance were not affected so largely by variations in the hardening temperatures.

11. The addition of 3¾ per cent of nickel to the customary chromium-tungsten-vanadium steels was beneficial for the roughturning tools, particularly when combined with a 50 deg. F. increase in the hardening temperatures, but was detrimental to the tools used under shallow cuts and fine feeds and adversely affected the machining properties of the high-speed steel itself. Lowering the carbon from 0.6 or 0.7 per cent to 0.5 per cent improved the machining properties without affecting the performance of the roughing tools, but was detrimental to the tools used under shallow cuts.

12. Each of the four elements, arsenic, antimony, copper, and tin, adversely affected the tool performance of high-speed steels under shallow cuts, and the magnitude of the decrease became greater as the proportions of these elements increased. Copper was the least harmful; next in order came tin, while arsenic and antimony were the most objectionable.

13. The effects of these four elements upon the performance of roughing tools did not necessarily correspond to those observed with shallow cuts. The 0.8 per cent arsenic additions lowered the cutting speed, but the addition of 0.4 per cent antimony or 0.5 per cent or less of tin had no measurable effect. Higher proportions of tin lowered the cutting speeds. The high-speed steels containing 0.36 to 1.77 per cent copper showed slightly better performance than the corresponding steels without copper.

14. The steels containing 0.4 per cent antimony, 0.8 per cent or more of copper, or 0.8 per cent arsenic did not have good hot-working properties, illustrated by numerous corner cracks on the bars, while those containing 1.7 per cent antimony or 1.8 per cent tin showed a high degree of hot shortness and could not be forged or rolled. Also the steel with 1.77 per cent copper could itself be machined only with difficulty in the annealed condition.

15. Phosphorus up to about 0.06 per cent and sulphur up to 0.215 per cent did not appear to be injurious, from the viewpoint of lathe-tool performance of the customary chromium-tungsten-vanadium steels, with or without cobalt. However, high sulphur tended to lower the cutting speeds in the presence of 3¾ per cent nickel. Because of the possibility of segregation of the phosphorus and the introduction of numerous sulphide inclusions in high sulphur steels, these two elements can advisedly be kept within low limits for all high-speed-steel lathe tools.

Aluminum Affects Steel Adversely

16. Aluminum adversely affected the performance of the high-speed-steel tools both with shallow cuts and under heavy duty. It was one of the few metals considered which, in proportions around 0.3 per cent produced a measurable decrease in the cutting speeds in roughturning. This decrease became greater as the proportion of the aluminum was increased, and with 0.8 per cent the drop in cutting speed was greater than that produced by equal proportions of any of the other elements considered. These changes were accompanied by a decrease in the hardness of the quenched steels, probably through decrease in the dissolving capacity of the aluminum-iron solid solution for carbon, chromium, tungsten, and vanadium. With 0.8 per cent aluminum, there was also evidence of a low-melting eutectic in samples quenched from 2,350 deg. Fahrenheit.

17. Titanium was another of the elements which appeared to lower the dissolving capacity of the austenite, and as a result the hardness and the cutting speeds of the high-speed-steel tools decreased with increase in the titanium. Its interference was lessened, probably through the formation of less harmful carbides instead of solution as titanium in the austenite, by increasing the carbon content of the steel.

18. Tantalum did not appear to be promising as a substitute for vanadium or as an alloying element in the customary chromium-tungsten high-speed steels for lathe tools. It acted in a manner similar to aluminum and titanium in that it appeared to decrease the dissolving power of the austenite for the chromium and tungsten compounds and so decreased the hardness and cutting speeds of the quenched lathe tools.

Quality Control and Production Gages

By EARLE BUCKINGHAM

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INTERCHANGEABLE manufacture was discussed for many years before it was realized as a practical manufacturing system. The advantages and probable economies of making the several component parts of products such as clocks, watches, and firearms such close duplicates of each other that they might be assembled without fitting, and be interchanged from one assembled unit into another, were almost self-evident. Early attempts to accomplish this consisted primarily of providing filing templets to which each part was to be matched or fitted. Thus these first examples of special productive equipment included in themselves both the manufacturing equipment and the production gages.

Clearances should be one of the principal considerations in developing the manufacturing design. This design should aim to allow the greatest possible amount of clearance between companion parts. The more the design lends itself to this end, the greater the economy of manufacture, and the greater the degree of interchangeability obtainable. In determining which parts of a mechanism can be made interchangeable, this matter of permissible clearance plays the largest part. A mechanism which is designed so that it cannot permit fairly liberal clearances is not a suitable one to be manufactured on a strictly interchangeable basis with standard equipment.

The general tendency in the past has been to establish manufacturing tolerances by trying to hold the product as closely as possible to a fixed size. The natural result of this policy is that the tolerances established on paper are often exceeded, yet the actual working variations remain unrecorded because it is argued that under certain conditions the original requirements might be met, and, therefore, the tolerances noted are the proper ones, even though they are not maintained.

Too often in manufacturing concerns, and especially in the case of interchangeable manufacturing, one finds details being made ends in themselves rather than means to an end. In producing a component part, the main object should not be to demonstrate how closely a fixed size can be approached; the aim should be to construct as economically as possible a mechanism that will perform certain functions satisfactorily. The knowledge of how accurately a machining operation can be performed is indeed invaluable in making the manufacturing design, but when that design has once been completed, interest should shift to the proper functioning of the completed mechanism. In most cases, the tolerances originally fixed are increased during the process of manufacturing without detriment to the mechanism. It is rarely that a tolerance has to be reduced.

The proper minimum clearances can be determined quite readily and definitely for most cases in the early stages of the work. The maximum clearances become established only after extended experience with the particular mechanism. In many cases, the extreme maximum is never found, because long before that point is reached, the tolerances have become so liberal that there is no need, from the standpoint of economical production, to increase them further.

Component drawings have two main functions to perform. The first is to give such information about the design, holding points, and tolerances that the manufacture of a product can be started.

In making component drawings, the effort should be made to give the dimensions and necessary tolerances so that it would be possible to lay out one, and only one, representation of the maximum metal condition and one, and only one, of the minimum metal condition. If such layouts were superimposed, the difference between them would represent the permissible variation on every surface. Any condition of the product which fell within the zone thus established should be considered as meeting the requirements of the drawing. There are always a number of dimensions that should be given without tolerances, if drawings are to be kept intelligible.

It must be realized at the start that it is impossible in every case to give on one component drawing all the dimensions that are needed to construct the patterns, tools, gages, and other manufacturing equipment without introducing many inconsistencies. Certain dimensions could be correct if one set of holding points and one series of operations were to be used, but might be incorrect under different conditions. If the component drawings are made so that they represent the proper completed conditions, the end in view is attained. Any figures that the shop desires to use are correct if they insure this result.

It is impossible to amplify this point without entering into a prolonged discussion of the effect of using different holding or registering points in the manufacturing processes. Yet it may be of interest to know that several manufacturing plants solve this problem by adding operation drawings, which give only the specific dimensions required at a particular operation. Some of the dimensions are duplicates of those on the component drawings, while others are computed to serve their restricted purpose. This proves an effective means of recording additional information required in the manufacturing departments, which cannot be put on the component drawings without danger of misuse.

After production is well under way, the component drawings have served their first purpose. In the meantime, the actual manufacturing operations have made available a store of new information regarding the proper conditions to be maintained. It should be the second function of the component drawings to record as much of this information as possible. Conflicting information, or misinformation, should be eliminated at the same time; in short, the drawings should be revised to agree with actual conditions and requirements.

The problem of the proper dimensioning of component drawings with tolerances is strictly a mathematical one. There are a few basic principles in regard to it as fixed and simple as Newton's three laws of motion, but even more difficult at times to apply correctly. Tolerances are necessary in commercial specifications only because of inability to produce absolutely identical parts. Tolerances should show the permissible amount of varia-

tion, and the direction of variation that is less dangerous. When a variation in either direction is equally dangerous a bilateral tolerance should be given. When a variation in one direction is more dangerous than a variation in the other, a unilateral tolerance should be given in the less dangerous direction.

Adherence to the following rules for dimensioning with tolerances will help to avoid inconsistencies with the resulting misunderstandings in the manufacturing departments:

1. Only one dimension in the same straight line can be controlled within fixed limits. This is the distance between the cutting surface of the tool and the locating or registering surface of the part being machined. Therefore, it is incorrect to locate any point or surface with tolerances from more than one point in the same straight line.
2. Every part of a mechanism must be located in each plane. Every operating part must be located with proper operating clearances or allowances. After such requirements of location are met, all other surfaces should have liberal clearances.
3. Dimensions should be given between those points or surfaces that it is essential to hold in a specific relation to each other. This applies particularly to those surfaces in each plane which control the location of other component parts. Many dimensions are relatively unimportant in this respect. It is good practice in such cases to establish a common holding point in each plane and give, so far as possible, all such dimensions from these common locating points. The locating points on the drawing, the locating or registering points used for machining the surfaces, and the locating points for measuring should all be identical.
4. The initial dimensions placed on component drawings should be the exact dimension that would be used if it were possible to work without tolerances. Tolerances should be given in that direction in which variations will cause the least harm or danger. When a variation in either direction is equally dangerous, the tolerances should be of equal amount in both directions, or bilateral.
5. The initial clearance, or allowance, between operating parts should be as small as the operation of the mechanism will permit. The maximum clearance should be as great as the proper functioning of the mechanism will permit.

If careful thought is given to these component drawings, much time and effort will be saved later in the shop.

There are three reasons for inspecting the product during manufacture. First, the set-up of the productive equipment should be tested before production is started. Second, spoiled parts should be eliminated as soon as possible to save the expenditure of useless effort on unserviceable pieces. Third, the finished components must be checked before assembly to eliminate the unserviceable parts, and thus insure the proper functioning of the mechanism. For these purposes, gages are extensively employed.

A gage should be provided whenever its use is more economical than the use of standard measuring instruments. The extent to which gages are necessary depends in great measure upon the amount of the total production. Furthermore, gages should be provided to check only those conditions which it is essential to maintain. The nature and extent of the gages required depend upon the manufacturing conditions. In many cases, a check on one or two points is sufficient to detect any unsatisfactory results. Gages are a preventive and not a cure. The point to be emphasized is that they should be provided whenever their addition will result in the production of more or better components with a total expenditure of the same or less effort.

There are two kinds of gages to consider, which for want of better terms will be called limit gages and functional gages. A limit gage is one that checks a specified dimension to specified tolerances. A functional gage is one that checks the relationship of several dimensions to insure the proper functioning of the assembled mechanism.

The degree of accuracy required on the gage depends upon the extent of the tolerances on the product. In all cases on limit gages, the variation should be inside the established limits of the component. The dimensions given on component drawings are limit gage sizes.

Gages are an integral part of the manufacturing equipment. They comprise that part of the equipment, the purpose of which is to measure the product, as distinguished from that part of the equipment, the purpose of which is to change the form of the material or to hold the part during a manufacturing operation. Under this broad definition of a gage, it is apparent that some of the manufacturing equipment may be not only a holding device but also a gage. In fact, it is good practice to make jigs and fixtures so that an unserviceable part cannot be inserted. It often happens that when the normal manufacturing variations of certain machining processes are small and within known limits, a gage may be employed to test the size or form of the cutting tool, and not be applied directly to the product. At other times, a gage in the form of a setting block for the position of the tool is made as an integral part of the fixture. Again, some types of grinding machines are fitted with sizing devices which stop the feed of the wheel when the work has reached a predetermined size, thus practically eliminating the need of continuous inspection. Therefore, to determine the character of the gages that are required for the production of any particular part, it is necessary to consider both the requirements of the parts in question, and the other manufacturing equipment provided.

The inspection and acceptance or rejection of the components of an assembly falls into two divisions. The first is the shop inspection which is made while the material is in process of manufacture.

The second division of the inspection is the final examination of the completed parts. The object of this inspection is to see that all components which will function properly are accepted, and that all unserviceable parts are rejected. This inspection is largely governed by the requirements of the component drawings, often represented by gages, and by any other specifications.

The characteristic need for a successful inspector is a judicial mind. Since the requirements are laws, the inspection should enforce them equitably. The spirit of the requirements should be enforced in those cases where their exact expression is incomplete. If the essentials are always specified definitely and completely, it will be a fair assumption that incompletely specified conditions are relatively unimportant. Wherever possible, the requirements should be revised to make the letter and the spirit agree, but the attempt to cover every minute and unimportant detail will prove impossible in practice.

Power Required to Drill Cast Iron and Steel

By O. W. BOSTON AND C. J. OXFORD

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THIS paper presents results of a series of tests in drilling steel and cast iron with sharp standard twist drills ranging in diameter from ½ to 1½ in. Data were obtained of the torque, thrust, and net horsepower developed at the point of the drill for some of the modern high-speed-steel twist drills, when cutting a variety of types of steels and cast irons widely used.

In arriving at these conclusions, it is to be understood that the drills used were supposed at all times to have a keen cutting edge and point. A cutting fluid consisting of one part of soluble oil mixed with 16 parts of water was used on all tests. Actual experimental results are given in every instance. For this reason there will be some slight inconsistencies in the data.

1. The torque remains practically constant at speeds ranging from 74 to 441 r.p.m. for both cast iron and steel and for various drill diameters when operating under constant conditions of feed, lubrication, and material.

2. The thrust remains practically constant at speeds ranging from 74 to 441 r.p.m. for both cast iron and steel and for various drill diameters when operating under constant conditions of feed, lubrication, and material.

3. The net input which equals the gross minus the load on the machine running idly, increases directly with the speed for the conditions mentioned under 1 and 2.

4. The torque increases with the feed, but at a slower rate, for a constant drill diameter and speed. For two cast irons, one carbon, and one alloy steel for various drill diameters from ½ to 1½ in. and for different speeds, the average conditions are represented by the following:

T = a function of $f^{0.6}$, for cast iron, and
T = a function of $f^{0.78}$, for steel.

5. The thrust increases with the feed, but at a slower rate when drilling cast iron and steel. For the conditions mentioned in 4, the following formulas represent average values:

Th = a function of $f^{0.6}$, for cast iron
Th = a function of $f^{0.6}$, for a carbon and an alloy steel.

6. In drilling a straight-carbon and an alloy steel with drills varying from ½ to 1½ in. in diameter, at constant speeds of 153 and 230 r.p.m., the torque increases with the drill diameter, but at a greater rate for both cast iron and steel. Average conditions for two cast irons, a plain carbon, and an alloy steel are represented as follows:

T = a function of d^2, for cast iron,
T = a function of $d^{1.8}$, for steel.

This may be expressed again, as follows:

$\frac{T_1}{T_2} = \frac{d_1^n}{d_2^n}$, in which T_1 and d_1 are the known torque and drill diameter and T_2 is the desired torque for the new diameter d_2, n is 2.0 for cast iron and 1.8 for steel.

7. For the conditions outlined under 6 the thrust is found to vary almost exactly in direct proportion to the diameter of the drill. The values for thrust may be expressed then, as follows:

Th = a function of d, for cast iron, and
Th = a function of d, for steel.

8. Combining the above relations of torque and thrust for cast iron and steel, general equations may be written as follows:

$T = C_1 f^{0.6} d^2$, for cast iron,
$Th = C_3 f^{0.6} d$, for cast iron,
$T = C_2 f^{0.78} d^{1.8}$, for steel, and
$Th = C_4 f^{0.6} d$, for steel, in which T is the torque in ft.-lb.,

Th is the thrust in lb., d is the diameter of the drill in in., f is the feed of the drill in in. per rev., and C may be called a "hardness class" number, or "machinability factor," that is, a constant depending upon the material being drilled. At the present time, the authors know of no way, except by actual drilling tests, to predetermine these constants for torque and thrust, for a particular metal.

9. The output horsepower at the drill point may be computed from the torque T and thrust Th, from the formula

$$\text{Hp. (computed output)} = \frac{2\pi TN}{33{,}000} + \frac{ThfN}{12 \times 33{,}000} = 0.0001904\ TN + 0.00000252\ ThfN = N(C_5 T + C_6 Thf),$$

in which N is the r.p.m. of the drill, f is the feed in inches per revolution of the drill and C_5 and C_6 are constants. It is seen then that the output horsepower at the drill point as computed from the torque and thrust is directly proportional to N. While the value of the thrust in pounds is usually relatively large, the resultant horsepower is only ½ to 2 per cent of the total computed. For general purposes, then, the output horsepower developed at the point of the drill may be assumed to be a result of the torque only, or

Hp. (computed output) = $0.0001904\ TN$, in which
$T = C_1 f^{0.6} d^2$, for cast iron, or
$T = C_2 f^{0.78} d^{1.8}$, for steel.

10. The results of the metallographic study may be summed up as follows: The 17 samples of steel as a group are arbitrarily divided into three classes, the first class showing a normal pearlitic structure, or one showing a very slight spheroidization; the second class consisting of those steels which are partly spheroidized, that is, advanced beyond the beginning stage of spheroidization; and the third class, those very nearly completely spheroidized. A direct connection with the torque in drilling is evident, although the greater the torque the greater is the degree of spheroidization. This is just the opposite of what might be expected if all bars were of the same chemical composition.

11. By grouping the materials according to chemical composition in order of increasing torque on the 1-in. drill, a fairly close grouping according to chemical composition, or type of steel, is obtained. This arrangement tends to indicate that the type of steel, the carbon content, and the microstructure are all important factors in determining the value of the torque in drilling.

12. No satisfactory correlation between the hardness values as determined by the Brinell, Rockwell, scleroscope, or the Herbert pendulum hardness tester, and the drilling torque for a given specimen, is evident.

Twelve Years' Experience with Economic Production Quantities

By C. H. Best

Supervisor of Materials, Eli Lilly & Company

THE firm of Eli Lilly and Company manufactures and ships from stock approximately 2,400 products which are marketed in over 8,500 different packages. The problem is to maintain stocks of these 8,500 different items at the lowest possible combined cost of labor of preparation and charges for carrying the merchandise until it is sold.

It was recognized long before 1917 that the quantity produced in a single batch was one of the important factors in determining the cost of producing and carrying merchandise. Charts and curves were drawn to assist the individual whose judgment determined the batch sizes. These aids were better than nothing, but they could not even approach the solution of the problem.

In the early part of 1917, work was begun on the assembly of data from which to derive mathematical formulas that would determine the economic production quantity. The task was to express algebraically the total cost of producing a batch of merchandise and of carrying that merchandise until it was sold. This expression has been termed the "total-cost expression," and will be referred to by this term. The first derivative of the total-cost expression, when set equal to zero and solved, gives the economic production quantity or the cheapest batch size that can be made. Larger or smaller batches than this quantity will produce a higher unit cost than batches made in this exact amount.

The formula used is

$$N = 262.8\sqrt{\frac{Y}{M + 202}}$$

where N = economic production quantity in units
Y = number of units sold per year, and
M = cost of material in cents per unit.

The solution is an easy slide-rule calculation.

To sum up, economic production quantities have afforded, or have assisted in affording, the following advantages to the company:

1. Considerably more production with 13,453 batches in 1928 than with 25,633 batches in 1917.
2. Considerably more production with a labor force of 482 in 1928 than with one of 554 in 1917.
3. Planning-department supervision of production at reasonable cost.
4. Increase in application of mechanical handling of materials.
5. A reduction of 21½ per cent in raw-material inventory.
6. An increase in turnover of finished-stock account from three and two-thirds times per year to four and one-third times.

It would be quite impossible to designate a specific cause as being responsible for any of the six advantages listed. It is undoubtedly true, however, that the application of the principle of economic production quantities has contributed its share toward making these economies possible.

It would be very convenient if unit costs of record in the cost department could be used directly in the formulas for the determination of economic production quantities. The cost plan furnishes a unit cost of production for each batch of merchandise processed. This unit cost is broken down into a unit material cost and a unit processing cost. Burden is included in the latter.

Following are some of the items of costs which are included in burden, although each item represents a practically constant cost per batch, regardless of the number of units to be produced:

1. Preparation of complete data on stock and sales to serve as notice that stocks must be replenished.
2. Blue-printing and registration of the production order.
3. Adjustments to perpetual-inventory records for raw material to be used.
4. Weighing, checking, and verifying raw materials in the stock room.
5. Scheduling production by the planning department.
6. Checking or assaying the finished product.
7. Calculation of the bottling and finishing orders.

An hour of time spent on the operations listed is just as expensive as an hour of labor in a production department. These costs cannot be carried as overhead charges into an expression of unit cost if the expression is to be differentiated to determine the batch size that will give a minimum unit-production cost.

The cost data for use in the formulas were obtained by adjusting the unit labor cost of record. Such elements of this cost as are shown above were introduced into the total-cost expression as a series of costs per batch. The unit labor cost of record was reduced to compensate for those component parts of this cost that had been introduced, in some other manner, into the total-cost expression. The remainder of the unit labor cost was then used as the unit cost of the actual production. In this way as much use as possible was made of the existing record of costs.

During the first seven months of 1929, the costs in one department, including overhead charges, represent an annual saving of $11,950. The annual saving will probably reach $15,000 when the full benefit of the change in equipment and production systems introduced during the preceding year by the company is realized.

The experience of the company with the application of the principles of economic production quantities indicates that it is just as necessary to study the cost-accounting system as it is to study the problems of the production department. In fact, the cost-accounting problems have been more difficult of solution than the production problems.

Crosshead Slipper Practice at the C. & N. W. Shops

A system has been devised whereby slippers, when worn, are re-machined and given a second run before being scrapped — Welding crosshead guides

By Frank J. Oliver, Jr.
Western Editor, American Machinist

IN ORDER to get as much service as possible out of crosshead slippers and crosshead guides, it is the practice on the Chicago & North Western Railway to machine all new slippers to an inside width of 6¼ in. and all new or rebuilt guides to 6½ in. The new slippers are used with worn guides that have been planed to 6¼ in. Similarly, new or rebuilt guides are used in conjunction with worn slippers that have been planed to an inside width of 6½ in. The next time the slipper is removed from service it is scrapped. Guides need never be scrapped, as the sides can always be built up by welding when they run under 6¼ in. in width. Wear on the faces can be compensated for by varying the thickness of the liners or shims. After each servicing, however, they are usually sent to the blacksmith shop for straightening.

After the first wear period, the slippers are re-babbitted, then machined. First, of course, the old babbitt is removed. This is accomplished by floating the cast-iron slipper upside down in the molten bearing metal. An air hoist is used to handle the casting, as can be seen in Fig. 1, the piece being placed on a shelf on the side of the tank and eased into the bath by the operator.

When the casting is free of babbitt, it is pulled out and allowed to cool. Pouring of fresh metal is done with the aid of the simple device shown in Fig. 2. Two pieces of 2-in. plank, each sawed with one side at a slant, are wedged in between the sides of the slipper and are hammered to make close contact with the bottom. Two C-clamps with setscrews are then used to clamp the wooden pieces in place. The use of wood is particularly advantageous in the case of new, unmachined castings, because it more readily conforms to the irregularities of the surface than would a metal. The babbitt is poured from a ladle through the open ends of the rectangular grooves in the sides.

The next and final operation is to plane the slippers to the desired width of 6¼ or 6½ in., depending upon whether the castings are new or have been in service. Ten of them are planed at

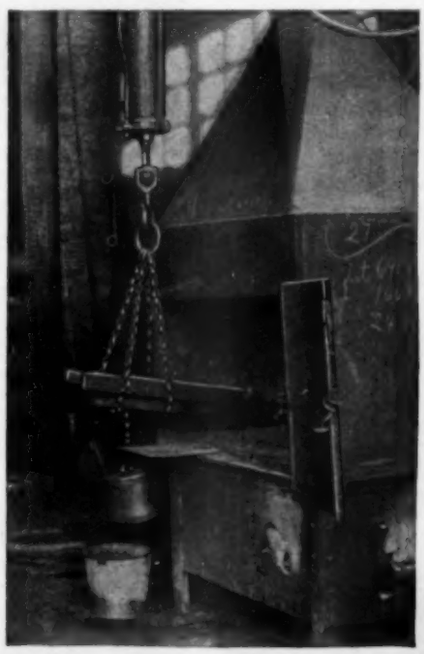


Fig. 1—Crosshead slipper suspended from an air hoist preparatory to being plunged into the babbitt bath for removal of the old bearing metal

Fig. 2 — Re-babbitting crosshead slippers. Wooden blocks, wedged together and held by C-clamps, bound the flow of the bearing metal. The wood conforms to the irregularities of the surface of the rough casting and acts as an effective seal. Fig. 3—Through the use of channel-shaped fixtures, two rows of crosshead slippers can be planed at once. The channels conform to the dovetail on the back of the castings. Setscrews are used for clamping

Cost of Welding Two Guides by Hand

24½ hours of labor @ $0.85	$20.82
52 lb. of ¼-in. welding wire @ $6.75 per 100 lb.	3.51
190 kw.-hr. electricity @ $0.01	1.90
Total cost	$26.23

Cost of Welding Two Guides on Automatic Machine

12 hours labor @ $0.85	$10.20
37 lb. of 5/32-in. welding wire @ $8.25	3.05
55 kw.-hr. electricity @ $0.01	.55
Total cost	$13.80
Saving over hand methods (pair)	$12.43

once with the aid of two trough-like fixtures on the planer table and the use of two tool heads, as shown in Fig. 3. The fixtures are shaped to fit the dovetail on the back of the slippers, and a pair of setscrews is provided to hold each casting in place. With this arrangement it is a simple matter to set the castings quickly in the correct position for accurate planing.

Building up the crosshead guides by welding, formerly a hand job, is now performed on an automatic machine. The unit is built up around an old lathe. No use is made of the headstock, but the carriage and feed screw propel the welder head along the work. Figs. 4 and 5 show two views of the machine. An objection to this arrangement is that the friction load, caused by the weight of the head, is somewhat severe on the lead screw, which wears and has to be recut occasionally.

An extension plate has been welded to the carriage at the rear, and on it four round columns, or posts, are erected. The welder head slides up and down on these

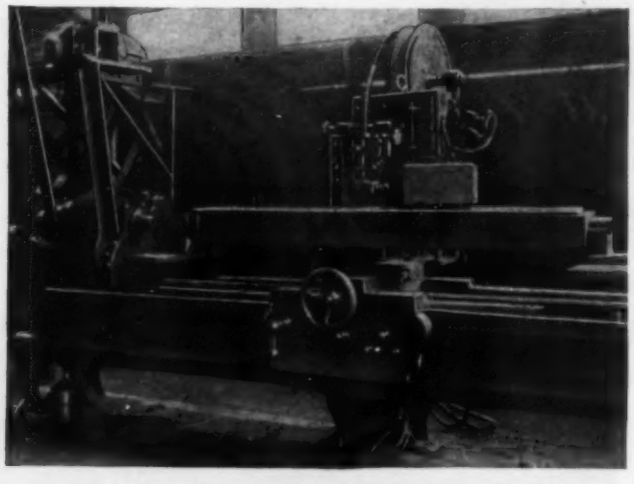


Fig. 4—Automatic welding machine for rebuilding crosshead guides. A standard electric welding unit is mounted on the rear of the saddle, and two guides, clamped together face to face, are carried in special trunnion holders

columns, the movement being actuated by a screw and handwheel. A standard Westinghouse automatic welder unit is mounted on the movable platform, and means are provided for carrying the reel of welding wire in an elevated position at the rear.

Two crosshead guides are mounted in the machine at once, although only one is welded at a time. They are clamped together, face to face, but ½ in. apart, with a yoke-type of clamp having a trunnion journal extending

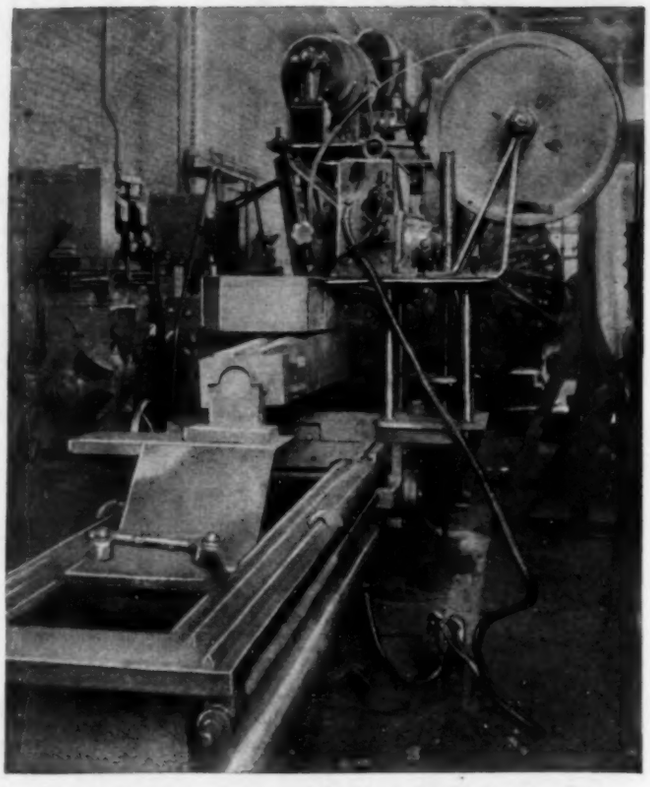


Fig. 5—End view of the machine, showing the rear extension of the saddle and the four posts upon which the welding unit is adjustable vertically. One of the work-holding trunnion devices can also be seen

parallel to the axis of the work. These trunnions rest in half bearings mounted on special platforms made of bent flat stock. One platform is bolted under the headstock, the other to a modified tailstock. Sheet metal covers protect the exposed trunnions from spattering metal. When one side of each guide has been welded, the fixture is swung a half turn on its trunnions, and the other sides are welded.

About ½ in. of metal is built up on each side, two trips of the carriage per bead of deposited metal being necessary. A feed of 6 to 12 in. per min. is obtainable on the carriage. Welding wire 5/32 in. in diameter is used.

Not only is a more uniform deposit obtained than by hand welding, but it is obtained at about half the cost, as a comparison of the figures given herewith will show.

AT LEAST 65 per cent of the air compressors now in service are "over-lubricated," that is to say, the supply of oil is too great, and, as a result of this excess feeding, oil is spashed around in the cylinder coming into contact with the hot and fast moving air, the oil is atomized and carried out of the cylinder with the air. Some of this atomized oil is deposited on the valves, pipe lines, and in the receivers. This forms carbonaceous deposits which are detrimental to efficient operation and necessitate untimely tear downs. An unsuitable oil must be fed in excessive quantities in order to obtain a complete separation in the moving and stationary parts. Some of this oil is deposited on the valves and, of course, solid impurities deposit there also. The hot air continually passing over the valve bakes this paste, or oil, solidifying impurities into a hard carbonaceous deposit.

IDEAS FROM PRACTICAL MEN

The department, "IDEAS FROM PRACTICAL MEN," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit.

Pneumatic Dolly for Flexible Staybolts

BY GEORGE BEXTON
Stratford, Ontario, Canada

IN RIVETING staybolts in boilers some sort of a holder-on, or dolly, is necessary to hold the bolts in position and to absorb the shocks of the hammer blows. In the illustration is shown a type of pneumatic dolly for use in riveting flexible staybolts in locomotive boilers, together with some of its details.

In Fig. 1 is a general assembly view of a pneumatic dolly screwed into the sleeve of a flexible staybolt. In Fig. 2 is a dolly of the same type fitted with an adapter for use where the threads are on the outside of the staybolt sleeve. An adapter for the later style of U. W. type staybolts is shown in Fig. 3. Such adapters can be made to fit staybolts of all sizes and types.

The piston, Fig. 4, is made of carbon steel and is heat-treated. It should be quenched at 1,450 deg. F. and drawn to 500 degrees F. Four holes, equally spaced, are drilled from the ring groove and meet in a $\frac{3}{8}$-in. hole drilled axially in the body. The purpose of these holes is to allow the air pressure to keep the leather packing in the ring groove against the cylinder wall and prevent leakage of air past the piston.

The cylinder, Fig. 5, is made of machine steel. It is casehardened, and the bore is ground. The outside is knurled to provide a good gripping surface for screwing it in the staybolt sleeve.

Connection to the air line is made through a cock and a flexible joint.

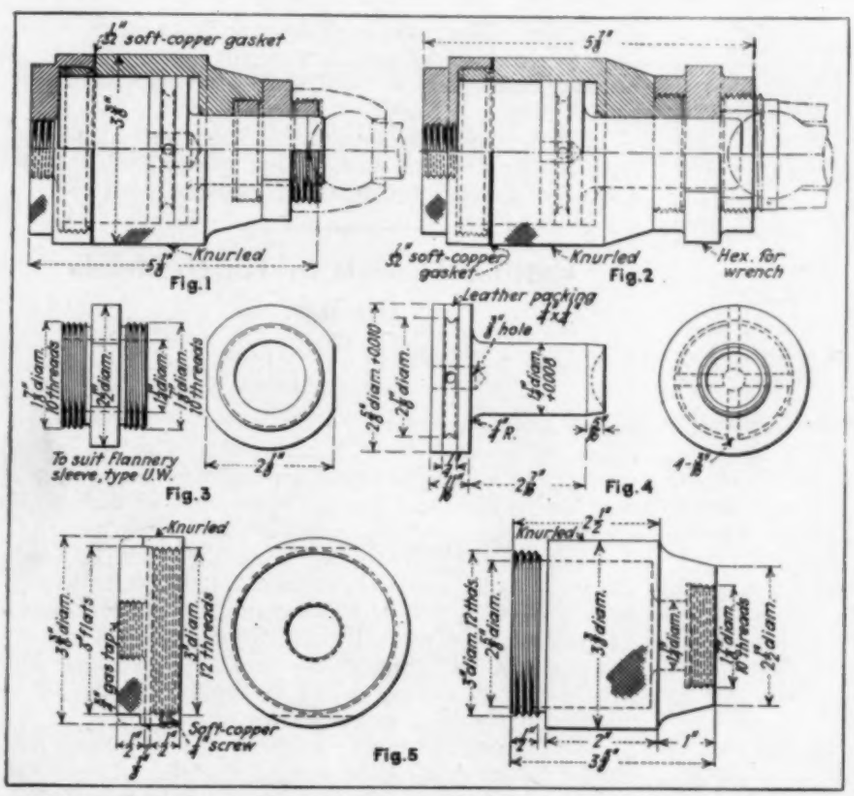
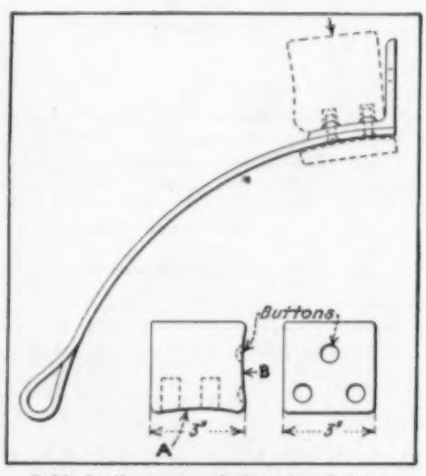


Fig. 1—General assembly view of pneumatic dolly. Fig. 2—Dolly with adapter for outside threads on the staybolt sleeve. Fig. 3—Adapter for later styles of U. W. Fig. 4—The piston. Fig. 5—The cylinder

Block Simplifies Cold Riveting

BY FRANK J. OLIVER, JR.

Air reservoirs used on locomotives of the Chicago & North Western Railway Company are held in place under the running board by strap hangers made in two halves and bolted together at the middle to facilitate mounting



Cold riveting an angle-iron bracket to a flat strap with the aid of a form block

of the tank. The connection is made by running a bolt through two pieces of angle iron each riveted to its own half strap, as shown in the illustration. One of the problems in connection with this construction was to find a cheap and quick method for performing the riveting operation.

The method now used is one of cold riveting under a hydraulic press. Three $\frac{3}{4}$-in. rivets are used, and it takes about 50 tons pressure to set

them cold. Two strokes of the press are required, using a simple form block shown in the lower right of the illustration. The first step is to insert the rivets by hand and place the strap against a bolster plate the upper surface of which conforms to the curvature of the piece. Countersunk heads are used on the underside so that the piece lays flat. The angle iron, already punched, is then slipped over the rivets, and the pressure block placed on top with face *A* in contact with the work. In this face holes are drilled into which the rivets protrude. When pressure is applied the angle iron is bent to conform to the curvature of the strap. In the succeeding operation, face *B* of the pressure block is placed against the rivet ends which are then cold pressed to form the heads. The entire operation takes only 1 min. Formerly each rivet had to be set hot by hand.

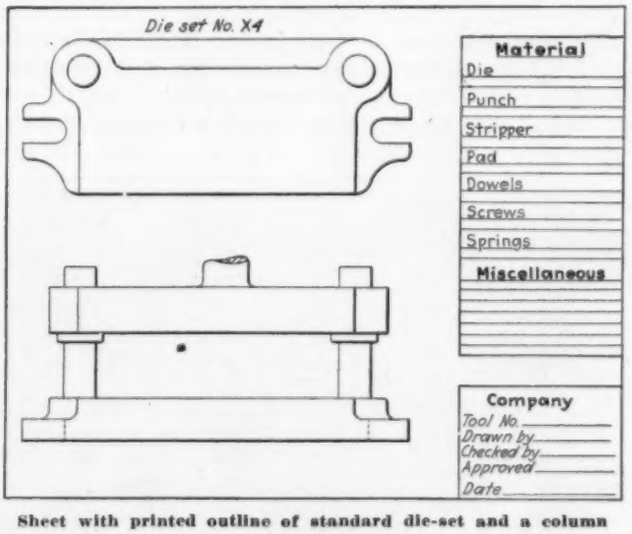
Saving Time in Die Design

By Philip F. Shafran

Machine Shop Instructor, James Monroe High School

In designing punches and dies, it is customary to outline the die-set and then locate the various parts of the tools on this outline. Where a number of dies are to be designed, considerable time can be saved if one of the following plans is adopted.

The first plan is to make a master drawing of each



Sheet with printed outline of standard die-set and a column for materials

size of die-set that is to be used. A master drawing is placed under the tracing paper when designing a die. The die can then be drawn in place, and the die-set can be traced. A free-hand tracing of the die-set is usually sufficient, and offers contrast to the rest of the drawing, which is an advantage.

The second plan would be to have tracing sheets prepared with printed outlines of the die-sets and with material columns, such as shown in the accompanying illustration. The designer need then only draw in the punch and die, with the necessary details, and enter the required materials in the material column.

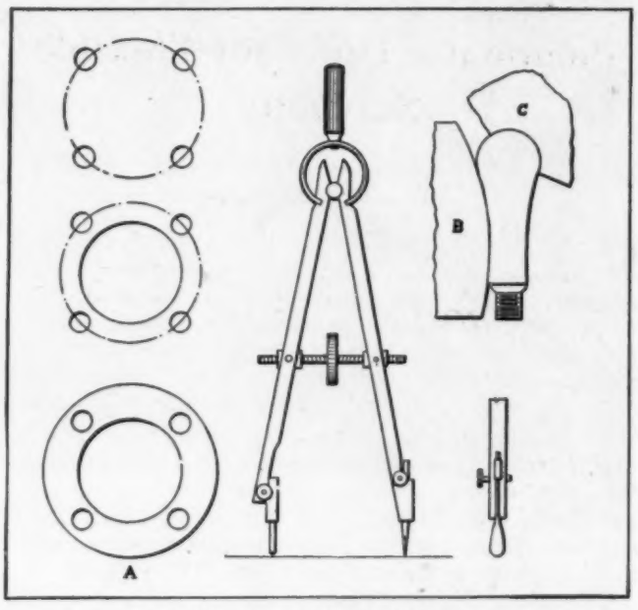
It would be an excellent idea for manufacturers to provide such sheets to those who order their die-sets. Such practice would prove an added inducement to the prospective customer and would also help to standardize die-design procedure.

Circle Cutter for Paper Templets

By L. Coon

Draftsman, Kellogg Manufacturing Company

For cutting paper templets of circular shape, there is nothing better than a sharp cutting blade inserted in a pair of dividers or bow compasses in place of the pencil lead. Such an arrangement is shown in the center of the



Cutting templets with dividers

illustration. The cutter is made of 0.070-in. music wire. It is flattened at one end, filed to the shape desired (a rounded chisel-point is best) and is then hardened and ground.

At *A* is shown the sequence of operations in cutting templets for drawing washers and gaskets, while at *B* and *C* are templets for drawing a handle.

Cutting Threads in Tough Metals
Discussion

By J. T. Towlson

London, England

The article by Arthur F. Parker, under the title given above, on page 32, Vol. 71, of the *American Machinist*, is certainly interesting, more especially as it comes as a surprise to one who has cut thousands of threads in copper, in holes varying from $\frac{3}{8}$ in. to 6 inches.

In cutting both inside and outside threads in tough materials, lathe hands on this side of the water have a habit of feeding the tool forward and backward by means of the compound rest. By this method, the tool cuts on one side of the thread only and is never crowded. Inside threads are cut nearly to depth, and the job is finished by running in a standard tap.

This method, I think, is preferable to cutting the thread by using a tap of smaller size than that of the hole, but of the proper pitch, as described by Mr. Parker, and then not being sure that the thread is of the right diameter.

Methods of Measuring Odd-Fluted Taps

ODD-FLUTED taps may be measured by five methods. The first method is by micrometer calipers fitted with V-anvils, as shown in Figs. 1 and 2. Bench set-ups for short and long taps respectively, are shown in Figs. 3 and 4. The angle of the V for 3-fluted taps is 60 deg., for 5-fluted taps, 108 deg. The micrometers are calibrated as shown in the formulas: D is major diam.; E, pitch diam.; A, calibrating gage diam.; p, pitch; G, diam. of wire; M_d, major, and M_e, pitch, diam. micrometer readings obtained when micrometer reads zero over the gage diam. A.

1. The major diam. of a 5-fluted tap, measured as shown in Fig. 1*a*, is:

$$D = 0.8944\ M_d + A$$

If the major diam. is basic, the pitch diam. is obtained by the same set-up with one wire in the thread. Then:

$$E = 0.8944\ M_e + A + 0.0282\ p - 1.3416\ G$$

This formula is of little use, since taps are regularly made larger than basic on the major diam. The proper procedure is to support the tap on three wires in the V and place a fourth under the micrometer spindle, as in Fig. 5, all wires being of the same diam. Then:

$$E = 0.8944\ M_e + A - 3G + 0.86603\ p$$

This formula is derived as follows:

$$B = \frac{G}{2}\cot 30° \frac{p}{4}(1 + \csc 30°) -$$

$$M_e = \left(\frac{E}{2} + B\right)(1 + \csc 54°) - \frac{A}{2}(1 + \csc 54°)$$

$$E = \frac{2\,M_e}{1 + \csc 54°} + A - G(1 + \csc 30°) + \frac{p}{2}\cot 30°$$

$$= 0.8944\ M_e + A - 3G + 0.86603\ p$$

Similarly, for 3-fluted taps, using 4 wires:

$$D = \frac{2}{3}\ M_d + A$$

$$E = \frac{2}{3}M_e + A - 3G + 0.86603\ p$$

2. By means of the Zeiss universal measuring microscope, pitch diam. is measured with knife edges applied first to one side and then to the other after the tap has been indexed and fractional lead compensated by longitudinal shifting.

3. Readings may be taken on a single wire, preferably of the "best size" for the pitch concerned, inserted in the thread space of a tap mounted on centers. The readings thus obtained are referred to readings over a cylinder of known diameter, held similarly. They are taken with the aid of an indicator or dial micrometer having a flat anvil so adjusted that the measuring surface is parallel to the axis of the tap. The average of readings taken on each flute in turn is used. From the average readings over the wire and over the cylinder, the value of M, which corresponds to measurements over wires in the 3-wire method, is determined. The pitch diam. of a 60-deg. thread is then:

$$E = M - 3G + 0.86603\ p$$

where E is tap pitch diam.; M, diam. over wires; G, diam. of wires; and p, pitch.

The pitch diam. of an interrupted thread, odd-fluted tap may be measured by means of wires in a modification of the preceding method. Two wires of the "best size" for the pitch, equal to 4/3 of the pitch of the tap being measured, are placed symmetrically side by side in the same thread, as in Fig. 6. The average of readings on each flute is used. The pitch diam. for a 60-deg. thread is then:

$$E = M - 4.73205\ G + 2.59815\ p$$

derived by assuming that an imaginary wire of diameter G' is inserted in thread spaces on opposite sides of the tap, and by employing the usual 3-wire formula, thus:

$$E = M' - 3G' + 3/2\ p \cot 30°$$

where M' = diam. measured over imaginary wires and G' = diam. of imaginary wires. From Fig. 6 it is evident that:

$b = G/2 \tan 30°$ and $c = G/2 \sec 30°$ and that $G' = G(1 + \sec 30°)$

$$M' = M + G(\tan 30° + \sec 30°)$$

Substituting these values:

$$E = M - G(3 + 2 \sec 30° - \tan 30°) + 1.5\ p \cot 30°$$

or $E = M - 4.73205\ G + 2.59815\ p$

4. The Jones & Lamson "Hartometer" thread gage, shown in Fig. 8, can measure 3-fluted taps. The "zones" shown are used in measuring variation of tested-piece lead from standard lead.

5. An indicating caliper or snap gage, suitable for checking odd-fluted taps, shown in Fig. 7, was developed by F. O. Wells.

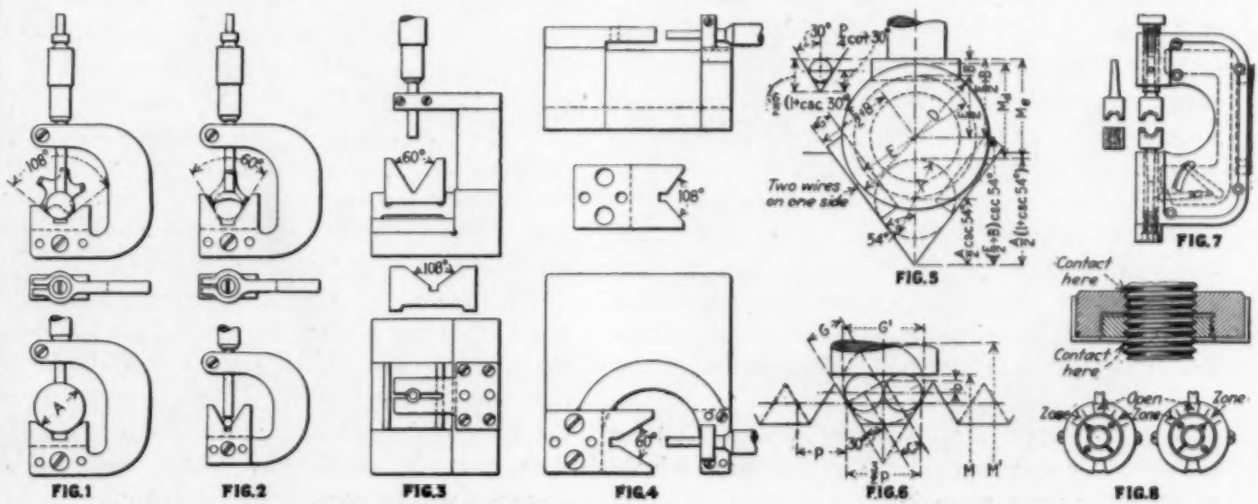


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6 FIG. 7 FIG. 8

Condensed from National Screw Thread Commission Bulletin No. 143

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Real Values

WALL Street has a headache. So have other stock speculative centers. And business in general is bothered by that uncertain feeling that often succeeds overeating, that uncertain and ill-defined question whether what has been engulfed is going to be absorbed—or not.

As during a morning after a night before, the judgment of the sufferer is likely to be adversely affected. Consequently he must make extra effort to be sure that his plans for the future are based on facts, and not on emotions. The prosperity of the next few months will vary directly as the ratio between facts and emotions used in such planning.

Are we going to be guided by the rumor that thousands of people have been ruined, or by the fact that in the companies where aid was offered to employees that had suffered in the stock market the proportion of those who asked help was from one in two hundred to one in two thousand?

Are we going to throw out market analysis and the kind of advertising that is based on market analysis because they are relatively recent acquisitions and therefore, according to the old philosophy, the first to be discarded, or redouble our efforts to make sure that the markets at which we are aiming are the most fertile ones, and that our advertising is directed at the right men in the right market and contains the right sales appeal?

Are we going to carry on as usual with progressive replacement of obsolete plant and equipment, or get along with what we have for a while longer while our more alert competitors keep on with their own programs and secure a lead that will be almost impossible to overcome?

In short, are we going to overlook real values and be misled by our fears and the rumors that follow every market upset, or remember that there is just as much equity behind corporate stocks as there was before, just as capable operating staffs and just as skillful workers in our plants, and with but few exceptions the same consuming power in the domestic market and perhaps a little more in the foreign market?

Japanese Students at the World Engineering Congress

IN A letter just received from Fred H. Colvin, who has been attending the sessions of the World Engineering Congress in Tokyo for *American Machinist*, particular emphasis is laid on the fact that many Japanese students attended every session and listened with earnest interest. If there has ever been any question why the Japanese are making such rapid industrial and engineering progress, we have one of the answers right here.

There was a time when a similar gathering in the United States would have drawn a like group of respectfully interested students; but would that be the case today? Are not most of our engineering schools and colleges so thoroughly organized, both inside and outside the classroom, that the students would have neither the time nor the energy for attending such an engineering gathering? If the answer to this second question is in the affirmative, it is high time we took an inventory of our educational work to see whether all that is required of the students is really essential. It will not do to forget the kind of industrial competition that Japan can present when her engineers have progressed just a little farther.

*

The Time for Business Statistics

WHEN reason leaves a man's mind, and is succeeded by fear of the future, he is not unlikely to lose what poise remains in him, and to run with the mob. We have just witnessed a perfect example of such unreasoning emotionalism in the Wall Street upset. Most of the speculators were engaged in pure gambling, throwing their little dice without adequate factual information.

Will business men fall a prey to the same fear bred of uncertainty? Possibly so, but very probably not. Great advances in collecting and disseminating the statistics of business men have been made since the war. Because he has incontrovertible facts to steady his nerves, the business man is not so easily swept off his feet.

Business statistics are going to be put to the acid test in the weeks that lie ahead of us, but there is every reason to believe that they will do for business what might have been done in the stock market had trustworthy information been available. The faith of those who gather and use such statistics will be completely vindicated.

SHOP EQUIPMENT NEWS

Rockford Drawing Roll

ALTHOUGH the drawing roll shown was designed particularly for drawing shovel blades after the shanks had been pierced and drawn, it can be adapted for almost any general-purpose drawing work by the substitution of suitable drawing dies in the rolls. The machine has been developed by the Rockford Iron Works, Rockford, Illinois.

When the shovel piece reaches the machine, it is a T-shaped part, the cross member being the part from which the shovel plate is drawn. Six to seven passes are necessary to complete the piece. Two passes are made in the outside rolls, which act as a break-down, then one pass is made on the inside roll without adjustment, followed by several passes with adjustment. Two men are required to operate the machine and two shovels can be completed per minute. The stock is rolled from 1 in. down to $\frac{1}{16}$ in. in thickness in two heats. Reheating takes place after the break-down on the outside rolls. During the finishing operation, the shank is positively held and guided by a buggy running on two sets of tracks on the front of the machine.

The rolls, or rather the sections of rolls, are 30 in. in diameter and are made out of 0.65-carbon steel, heat-treated. The roll necks are 10 in. in diameter and run in bronze-bushed bearings. The dies themselves are made of special alloy steel and are held by dovetail joints and keys through the rolls proper.

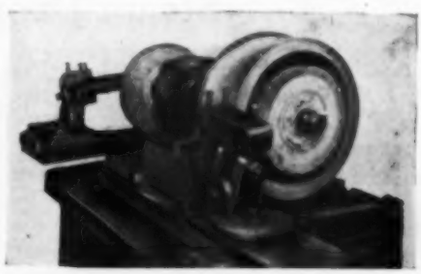
In operation, the rolls oscillate about 60 deg. The contacting gear sectors between the rolls have special cut steel teeth with long addenda so that a total adjustment of $\frac{3}{4}$ in. between rolls is available. The lower gear and roll is driven by a crank or pitman, which can be seen in the rear view of the machine.

Power is taken from a 20-hp. high-torque motor mounted on a special cap on the inboard pedestal bearing of the drive shaft. The flywheel weighs 4,000 lb., and is carried on four Timken bearings mounted in opposed positions at the two bearing locations. The outside bracket carrying the flywheel is supported on an extension of the base so that positive alignment is secured. Bronze-bushed bearings are used for the main drive shaft. The gears are made of steel with the exception of the motor pinion, which is micarta.

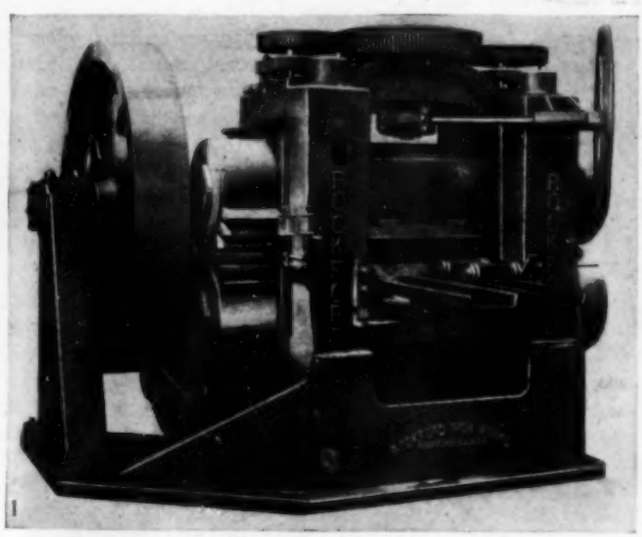
As in other machines of the Rockford line, the main castings are semi-steel and the uprights are keyed to the base, being held in place by four large-sized tie rods. Adjustment of the upper roll is by handwheel operating through a worm wheel and spur gear train.

"Advance" Combination Grinding and Lapping Machine for Tungsten-Carbide Tools

For shops using at least a dozen tungsten-carbide tools, the combination grinding and lapping machine illustrated has been developed by the Advance Diamond Tool Company, 427 W. Congress St., Detroit, Mich. The machine is equipped with the proper wheels for roughing and



"Advance" Combination Grinding and Lapping Machine for tungsten-carbide tools



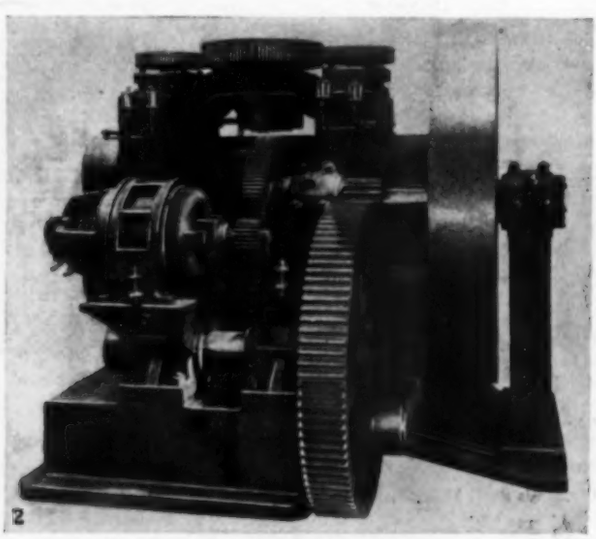


Fig. 1—Front view of the Rockford Drawing Roll, showing the work-holding buggy for supporting the shank of the work during the finishing operation. Fig. 2—Rear view of the machine showing the drive mechanism with pitman crank

finishing and they are driven at the proper speed. Two rim wheels for roughing and finish grinding are mounted as shown in the foreground of the accompanying illustration, the roughing wheel being 12 in. in diameter and having a 60-grain grinding grit surface and the other an 8-in. rim wheel having 120-grain grinding grit surface. On the opposite end of the machine there is located a diamond lapping disk.

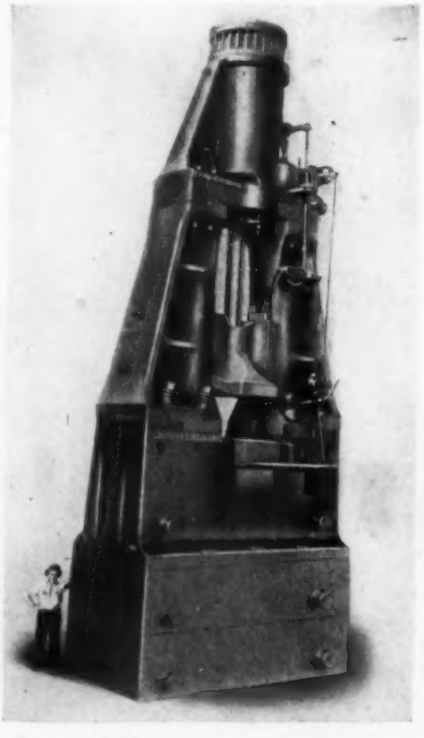
Both ends of this machine are provided with slides parallel to the faces of the wheels and upon each slide there is another cross slide for moving the universal vise in and out. The tool to be ground is put in the universal vise and the angles are adjusted to the requirements. The grinding is then accomplished by operating the slide across the face of the rim-type roughing wheel and then moving across the finishing wheel. Should diamond lapping be required on the same tool, the light cross-slide and universal vise with the tool mounted thereon may be quickly removed and placed on the slide adjacent to the lapping disk and finish lapped. The tool remains set up to the proper angle throughout the entire grinding and lapping operation.

The machine is equipped with an electric rheostat which permits using the exact speed necessary for grinding tungsten-carbide tools and is of particular value for such work because emery wheels may vary in hardness and, in order to insure the proper cutting of the wheel, the speed must be correct, as otherwise it would not cut at all or the tool would wear the emery wheel away. The machine combines the functions of rough and finish grinding and lapping in one machine and the accuracy of set-up is not impaired.

Chambersburg 24,000-Pound Steam Drop Hammer

ALTHOUGH of standard design, the Chambersburg hammer illustrated has dimensions considerably out of the ordinary. It has a falling weight of 24,000 lb., a cylinder bore of 32 in., and a stroke of 52 in. The steam line is 7 in. in diameter and the exhaust 9 in. The ram from front to back measures 66 in. and the distance between the guides is 42 in. The machine has been developed by the Chambersburg Engineering Company, Chambersburg, Pa. As is evident from the above specifications, the press has sufficient capacity to handle large size ingots after preliminary breakdown. It is of extra-heavy construction throughout.

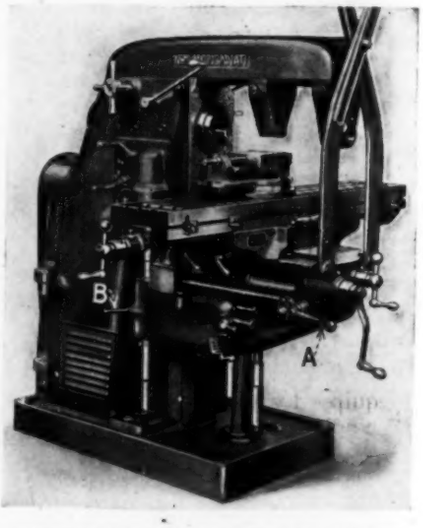
Because of the length of the work for which it is intended, the guides of this hammer are extra wide and are of the same type as those developed for the model H board drop hammer. The cylinder is lined, all valves are bushed, and all connections are fitted with roller bearings. The anvil is made in three sections to facilitate shipping and has a total weight of 482,000 lb., of which the upper section weighs 222,000 lb. The total weight of the complete hammer is 662,000 lb. The overall height of the hammer from the bottom of its three-piece anvil to the top of the head is 34 ft. 10 in. From the floor line it stands 24 ft. 4½ inches.



Chambersburg 24,000-Pound Steam Drop Hammer

Cincinnati Improved Type M Milling Machines

The type M milling machines, Nos. 1 and 2 plain, universal, and vertical styles, manufactured by the Cincinnati Milling Machine Company, Cincinnati, Ohio, are now equipped with power quick traverse in three directions. The rates are 100 in. longitudinal, 66 in. cross, and 33 in. vertical. The power quick traverse lever *A*, which is conveniently located at the left front side of the knee, as shown in the



Cincinnati Improved type M Milling Machine now available with power quick traverse in six directions, up or down, in or out, and left or right

illustration, has three positions as follows: upward, power quick traverse; horizontal, neutral, and downward, feed. To obtain the power quick traverse in a given direction, it is only necessary to engage the respective feed lever, move the reversing lever into position, and then pull upward on the quick traverse lever.

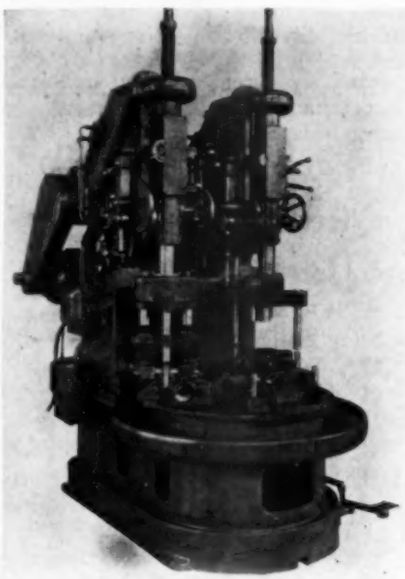
Feed in the same direction as the power quick traverse is obtained by moving the lever *A* into a downward or feed position. Means are provided for holding it in this position. Twelve feeds are available, that is ¾ to 30 in. longitudinal, ½ to 20 in. cross, and ¼ to 10 in. vertical, in both directions. Control of any one of the three feeds from the rear of the table can also be obtained by the use of the rear reversing lever *B*, a duplication of the front lever.

Barnes No. 242 Special Two-Spindle Production Gang Drill

EITHER three or four stations under hydraulic control may be had on the special No. 242 two-spindle special production gang drill developed by the Barnes Drill Company, 830 Chestnut St., Rockford, Ill. The entire hydraulic mechanism is inclosed within the frame of the machine. Other features are the inclosure of the spindle sleeve and spindle between the upper crown gear housing and the spindle sleeve bearing in each gang head, thus minimizing the possibility of chips getting on the spindle sleeve and scoring its bearings. This construction also makes it possible to self-oil the spindle in the sleeve. The six-splined Nitralloy spindle is carried in split bearings and the bearing cap is made of Gunite to resist abrasion in the sleeve. Roller bearings are carried in recesses in each end of the spindle sleeve and contact directly on the spindle, with no casing nor raceways for the rollers.

The gang drill here shown is equipped with a cam feed for the first spindle, giving rapid approach, feed at a predetermined rate, dwell for facing, and a quick return. The second spindle also has a cam feed for both reaming and tapping, according to the set up required. During machining, the operator reloads the spare station. The machine also is equipped with a hydraulic mechanism for throwing the multiple-disk clutches, which control all speeds and all feeds. The unit can be changed easily from one set up to another, and can be provided with spur geared feeds with or without the cam feed, as well as geared threading feeds.

The gang drill is designed to drill 2-in. holes in mild steel. Each head will admit 24 in., and the spindles are spaced at 28-in. centers. The diameter of the master indexing table is 54 in. The machine lends itself to the use of auxiliary heads having any desired number of auxiliary spindles. It requires but four seconds to index the table hydraulically, and the operator has only to reload the spare station and to actuate the foot pedal control. When the table has been indexed to its next station, the hydraulic mechanism actuates the throwing of the clutches automatically, and simultaneously starts the spindles upon another cycle. All control levers are brought to the front of the machine for quick changes of feed and speed.



Barnes No. 242 Special Two-Spindle Production Gang Drill which may be used for multiple operations on such parts as bearing caps

A coolant pump is attached to the end of the drive shaft and has a jaw clutch for disengaging it when coolant is not used.

Another feature is the sweeper attached to the under section of the rotating portion of the table. This sweeper pushes the chips around at each revolution and at the rear chips fall into a steel pan, perforated at the bottom so that the coolant goes on into the base of the machine, where it is pumped out again after being properly strained. The dry chips are placed in a receptacle, which may be slid out easily from the rear of the gang column.

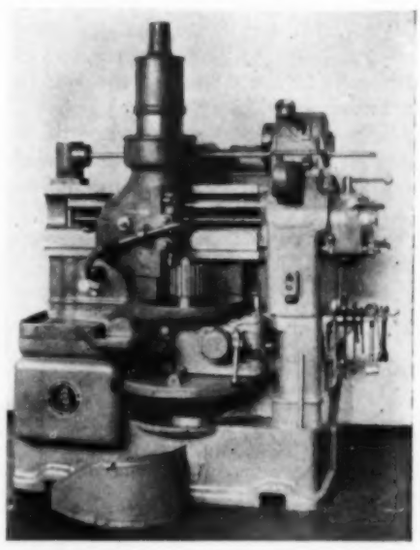
SPECIFICATIONS

Height of machine, in.	120
Diameters of spindles, nose, in.	3⅛
Diameter of spindle sleeve, in.	3¾
Spindle taper	No. 5
Vertical travel of spindle, in.	16
Distance from top of indexing table to floor, in.	39¾
Maximum distance from spindle to table, in.	31¼
Maximum distance from spindle to table, in.	15¼
Diameter of table, in.	54
Diameter over-all of chip trough, in.	56
Floor space, in.	90x56
Weight with 10 hp. motor and all attachments, lb., net	9,760

Fellows Improved No. 6A Gear Shaper

Since the original announcement on page 855, Vol. 69, of the *American Machinist*, several improvements from the operating standpoint have been made in the type 6A gear shaper manufactured by the Fellows Gear Shaper Company, Springfield, Vt. One of the principal improvements is the introduction of a friction disk clutch and a single pulley drive. These are completely inclosed by hinged guard. Incorporated with this single pulley drive is a disk brake located on the main drive shaft to enable the operator to stop the cutter travel at any desired point, a feature which has been found convenient when setting up. The capacity of the machine remains the same, 18-in. pitch diam., both internal and external, 5-in. face external and 3-in. face internal, and 3/4 diametral pitch.

Another convenience, especially where the machine is being used for production work, is the addition of



Fellows Improved No. 6A Gear Shaper

an opening in the cabinet so that the entire compound tank can be thoroughly cleaned out at intervals. A removable plate has been added to facilitate the filling of the oil reservoir in the stroke gearbox. In addition, a motor bracket of more simple design has been added. The last improvement is the provision of a holder at the right-hand end for all of the wrenches and tools used in the operation of the machine.

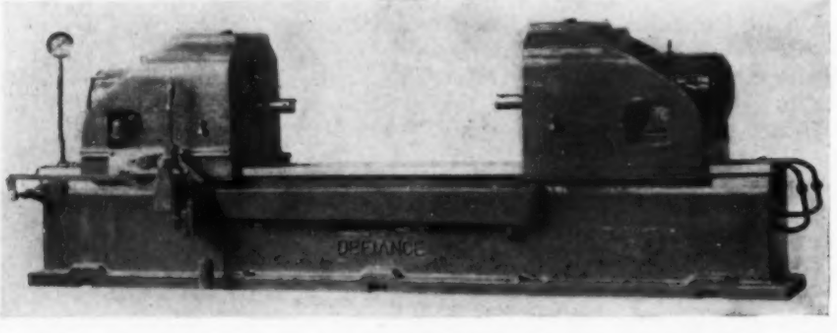
Defiance Two-Way Opposed, Horizontal Boring and Reaming Machine

THIS two-way opposed, horizontal boring and reaming machine was designed by the Defiance Machine Works, Defiance, Ohio, for production of automobile parts, gas engines, tractors, transmission cases, and similar work requiring boring and reaming operations, as well as a power unit for driving multiple-spindle drillheads. As shown, the machine is built with a single-spindle head. The head can be made with any diameter spindle or as many spindles as desired. The base is built in the proper length to suit requirements.

Heavy and wide broad ways on the base support the heads, and the ways are planed over the entire length of the base, leaving the center between the heads true and suitable for mounting and clamping work-holding fixture. The base is heavily ribbed and rigid throughout. Heads are thoroughly inclosed and have stub-tooth, heat-treated gears having splash or force feed lubrication. The spindles are made from heat-treated steel and run in anti-friction or bronze bearings, as desired. Minimum distance between the noses of spindles is 29½ in., the maximum distance being 57½ in. The height from the top of the ways to the center of the spindle is 12 inches.

The machine is equipped with an Oilgear pump or can be supplied with mechanical feed having rapid power approach up to the work, then the desired rate of feed with dwell for facing operation if desired, automatic kick-off, and rapid return. The Oilgear feed pump is driven with a separate motor. For driving the heads, the motors are mounted and attached direct to the drive spindle as shown.

The length of bed, the diameter and height of the spindle centers, the number of spindles in each head and fixture are always designed and built to suit the customer's particular requirements. Specifications of the machine shown are: Floor space occupied, 13 ft. 10 in. x 55 in. wide; net weight, 9,710 pounds.



Defiance Two-Way Opposed, Horizontal Boring and Reaming Machine

Mitchell No. 17 Motor-Driven Polishing Lathe

Herringbone gear drive is featured in the selective-speed, motor-driven polishing lathe announced by the Mitchell Engineering Company, Springfield, Ohio, and distributed exclusively by Frederic B. Stevens, Inc., corner of Larned & Third Sts., Detroit, Mich. Continuous-tooth herringbone gears are used, having the teeth cut at a 40-deg. helical angle, which insures noiseless operation and a large area of tooth contact. These herringbone gears have a face width of 2 in. and are capable of transmitting 25 hp., although the machines are available in sizes only to 10 horsepower.

Fig. 1—Mitchell Selective-Speed Motor-Driven Polishing Lathe equipped with a herringbone gear drive

Each spindle bearing assembly is mounted as an independent unit, and is readily removable from the motor without disturbing the motor or motor bearings. Each spindle is carried on two ball bearings, and the motor shaft is carried on two ball bearings, making a total of six ball bearings for the entire assembly. This construction prevents all undue strain and vibration on the motor bearings, and also minimizes the possibility of damage to the motor by the rotor striking the fields or stator should the spindle bearings wear out. Another feature is that the driving gears are keyed

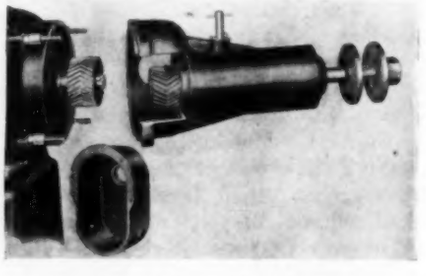


Fig. 2 — Showing the arrangement of the spindle and the motor bearings and how each spindle is driven by herringbone gears

to the motor shaft by means of a feather key which permits the rotor to float to its magnetic center. The gears are completely incased and run in oil, requiring replenishing only at long intervals.

It is possible with this spindle contruction to have one spindle operating at one speed and another spindle operating at a different speed. Spindle speeds obtainable are 1,800, 1,930, 2,070, 2,230, 2,400, 2,580, 2,780 and 3,000 r.p.m. The spindles

are well in front of the motor, giving a straight line front, and the cutting edge of the wheel is far out from the front of the machine.

Specifications are as follows: Length of spindles over all, 56 in.; diameter of spindles in bearings, 2 in.; distance between wheels, 45 in.; height from floor to center of spindle, 39 in.; size of base, 22 in. x 20 in.; net weight, 700 lb. The starting equipment consists of a magnetic switch with push-button control.

"Thor" No. 278 Rotary Pneumatic Wrench

The No. 278 rotary pneumatic wrench for operation at 170 r.p.m. has been placed on the market by the Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, Ill. A feature is that heavy-duty ball bearings are used at all vital points. A removable rotor liner is applied and it saves the cylinder from excessive wear and reduces maintenance costs.

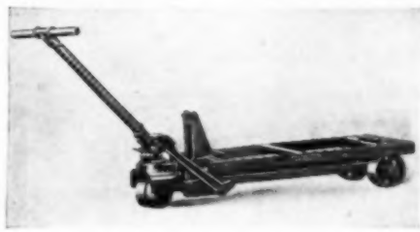
As shown in the illustration, the device has a very long drive shaft which has been found desirable on such work as removing caps from

"Thor" No. 278 Rotary Pneumatic Wrench

flexible locomotive staybolts. Ordinary locomotive boilers have from 600 to 750 of these flexible staybolt caps, and it was found that with one boiler maker and helper, the entire job can be done in six hours in contrast to two boiler makers and two helpers working eight hours to remove them by hand. The machine has sufficient power to remove these caps when they are rusted in. Furthermore, the long length of the drive shaft is of particular advantage when reaching in to get at the throat sheet. It is said that because of its fast starting torque the No. 278 wrench will break nuts loose from cylinder studs without backing the studs out. Dome nuts, superheater units, and frame bolts are also examples of work which can be handled with this device. The net weight is 40 pounds.

Lewis-Shepard "Footlift" Lift Truck

As the name implies, the "Footlift" lift truck is operated by stepping onto the lifting mechanism, the workman's weight lifting the load into the proper position for transportation. The truck has been placed on the market

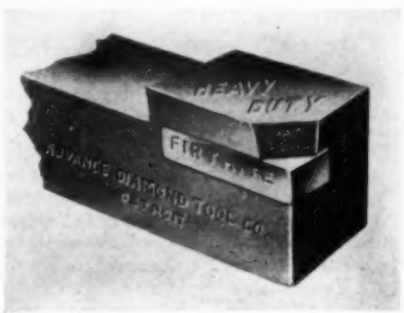


Lewis-Shepard "Footlift" Lift Truck

by the Lewis-Shepard Company, 176 Walnut St., Watertown Station, Boston, Mass. It is simple in construction, has several safety features, and a vertical release check. The handle is used only for steering and hauling, and a twist when in its upright position prevents it from falling when not in use. Also of importance is the fact that the handle is never connected with the load, so that there is no danger of a disengaged handle permitting the operator to fall backwards when pulling on the handle. The truck is capable of taking a load of 3,500 pounds.

"Bull Dog" Tungsten-Carbide-Tipped Tools

The process of welding a tungsten-carbide tip into a pocket in a tool shank has been developed by the Advance Diamond Tool Company, 427 West Congress St., Detroit, Mich. When regrinding the tool bit, the top part of the shank is removed only sufficiently to permit grinding and lapping the tungsten-carbide. Therefore, the tungsten-carbide is reinforced until it is entirely used up. It is claimed that this mounting prevents the breakage sometimes experienced under heavy cutting.



"Bull Dog" Tungsten-Carbide-Tipped Tools

Blount Wet Tool Grinder for Tungsten-Carbide Tools

For grinding tungsten-carbide tools, an improved wet tool grinder has been developed by the J. G. Blount Company, Everett, Mass. It is claimed to afford an easy, rapid method of grinding the said tools and prevents the possibility of burning or checking them.

The machine is of solid construction, having a heavy spindle running in extra-heavy, self-oiling bearings. A large reservoir for water is located in the column, and water is supplied to the wheel throuh a friction-

Blount Wet Tool Grinder for Tungsten-Carbide Tools

driven centrifugal water pump. The friction drive is easily adjustable and eliminates extra belting. The pump spindle bearings are located on the outside of the pump, thus eliminating any wear from grit in the water. Leakage around the pump handle and the necessity for packing are eliminated by the extension of the pump case cap well up on the spindle above the water level in the reservoir. The water is delivered to the rear of the wheel under force and the supply is easily regulated by a valve.

The machine is made in three dif-

ferent sizes, taking 14 by 1½-, 20 x 2½- and 30 x 3-in. wheels, respectively. These machines can be obtained for either belt or motor drive. They are fitted with a special wheel.

Ryerson Saw Blades for the No. 0 Cut-Off Machine

Two saw blades, one for cutting thin tubing and metal moldings and the other for the high-speed cutting of non-ferrous slab, have been placed on the market by Joseph T. Ryerson & Son, Inc., 16th & Rockwell Sts., Chicago, Ill. The first type has a solid blade with sharp teeth that can be re-sharpened. It is 24½ in. in diameter and $\frac{5}{32}$ in. thick. Cutting is done without leaving a burr. The speed when driven direct by the motor is about 3,600 r.p.m. The inserted-tooth saw, the second type, is also 24½ in. in diameter but ¼ in. thick, the kerf being $\frac{7}{64}$ in. Motor drive for this saw is by means of an 1,800 r.p.m. motor when directly connected.

REVIEW · OF · RECENT · PATENTS

Relating to the Machinery and Metal Products Industries

Metal-Working Machinery

To the Diamond Machine Co., has been assigned patent 1,724,115, on a swing-frame grinder with a fulcrum support, a motor and a wheel on opposite sides of the fulcrum, and suitable speed regulating means.

Three patents, 1,724,167, -8, and -9, relating to gear-cutting machines, have been assigned to the Dayton Curvometer Products Co. The patents involve cam-controlled means for forming the gear teeth.

Patent 1,724,241, assigned to the Gleason Works, relates to a machine to be used for producing tapered gears, and having means for adjusting the tool angularly about two intersecting axes, as well as means for moving the tool in a longitudinally curved path.

To the American Electric Fusion Corporation has been assigned patent 1,724,381 on an electric welder, combining fixed and reciprocable electrodes, means for applying pressure between the electrodes, and means for imparting the desired motion to one electrode.

Nelson P. Ridgeway, of Tacoma, Wash., has been granted patent 1,724,-419, on a rotary hammer, having the hammer element slidably fixed in a tubular carrier, and yieldable means for limiting the motion of the carrier.

The American Tool Works Co. is assignee of patent 1,724,430, on a radial drilling machine, involving a novel arrangement of pulleys and belts for driving the cross-shaft from a vertical shaft in the supporting column.

A machine for grinding hobs, worms, and like parts is the subject of patent 1,724,699, assigned to the Barber-Colman Co. The patent covers screw means for moving a slide, upon which the work is mounted, and other co-operating parts.

A nut and bolt assembling machine, comprising nut chucks mounted on rotatable carrier, bolt jaws in registration with said chucks, means for feeding nuts and bolts to chucks and jaws, respectively, and for screwing on the nuts, is the subject of patent 1,726,307, granted to Leonard Ober of Baltimore, Maryland.

Processes

To the Bendix Brake Co., has been assigned patent 1,728,172 on a method of making brake shoes that involves the forming of the shoe lining to compensate for inaccuracies in thickness after the lining is assembled to the shoe.

The method of and a mechanism for making blanking dies and the like, which involves grinding a surface from a guiding surface previously formed on material other than that of the material to be ground, are the subjects of patent 1,728,796, granted to Onni S. Koskinen, Detroit, Michigan.

To the General Electric Co., has been assigned patent 1,728,863 covering a method of electric arc welding while applying a vaporizable liquid to the electrode in order to produce a protective atmosphere about the arc and molten portions of the work.

A method of making steel ring segments from steel slabs by passing a portion thereof through bending rolls and then cutting off the unbent portions is the subject of patent 1,728,895, assigned to General Electric Company.

Patent 1,728,909, assigned to the General Electric Co., covers a method of making tools from a mixture of hard metal carbide powders having a melting point above 2,000 deg. C. and soft metal powders, involving the application of pressure, and thereafter sintering at high temperature.

TRADE PUBLICATIONS

AIR HEATERS, ELECTRIC. The Edwin L. Wiegand Co., 7500 Thomas Boulevard, Pittsburgh, Pa., has published a folder C-108A, showing its electric air heaters and strip heaters for use in isolated places, such as crane cabs, valve houses, and others.

GRINDING MACHINES. The Oesterlein Machine Co., Cincinnati, Ohio, has published a booklet entitled, "Precision Features of Oesterlein Grinders," which shows the features of these machines in progressive steps. The bulletin is well illustrated throughout.

HARDNESS TESTER. Edward G. Herbert Limited, Atlas Works, Levenshulme, Manchester, England, has sent a folder describing the Herbert pendulum hardness tester. The Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa., is agent in the United States.

MILLING CUTTERS AND HOBS. The Illinois Tool Works, 2501 North Keeler Ave., Chicago, Ill., has published Catalog D on its standard stock cutters and hobs and presents special types of tools. In the hob and gear cutter sections are data pertaining to gears and the use of hobs and gear cutters. The catalog is replete with tables and photographs. It contains 255 7½ x 5¼-in. pages.

WELDING MACHINES. The Lincoln Electric Co., Coit Rd. & Kirby Ave., Cleveland, Ohio, has issued a series of specification sheets on the various types of its 300-amp. welder. The specification sheets give the complete constructional and electrical features.

SCREW THREAD TABLES. The U. S. Department of Commerce, Bureau of Standards, has published bulletins 98 and 99 on the first and second parts of "American National Screw Thread Tables for Shop Use." The first deals with standard threads in coarse and fine series, and the second with special threads, particularly the 12-pitch series. These bulletins may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., for 10 cents each.

WELDED PIPING. The Linde Air Products Co., 30 East 42nd St., New York, N. Y., has published a 24-page booklet on the installation of oxyacetylene welded piping for industrial uses and also for welding piping systems for the heating of industrial buildings.

NEWS
OF THE WEEK

Technical Papers Hold Important Place In A.S.M.E. Meeting Program

Wide variety of subjects covered in sessions of divisions during annual assembly in New York

TECHNICAL papers of wide application and considerable value are the features of the fiftieth annual meeting of the American Society of Mechanical Engineers which is now in progress at the headquarters of the Society in the Engineering Societies Bldg., 29 West 39th St., New York City. Delegates from the entire country are in attendance. A number of social events and committee meetings are also a part of the program.

Some of the papers of particular interest to the metal-working industry are presented in abstract form on pages 935 to 940 of this issue. Other papers will be abstracted similarly in next week's special *Product Engineering* number of *American Machinist*. A number of additional papers of interest are obtainable from the headquarters of the society in the form of preprints.

A "Test Code for High-Speed Steel for Turning Tools" was submitted by one of the sub-committees of the special research committee on the cutting of metals. The code brings into consideration the composition and heat-treatment of the tool steel to be tested, as well as the characteristics of the material to be cut by the test tools and the general conditions governing the test. The code is particularly applicable to high-speed steel intended for manufacture of lathe and planer tools, and contains instructions to govern every step of the test, as well as a suggested log form for the data.

A further paper on economic production quantities by Fairfield E. Raymond, whose S.A.E. production meeting paper on the same subject was published in abstract form on page 669, Vol. 71, of *American Machinist*. The present paper is entitled, "Advantages Derived from the Simplification of the Fundamental Formulas for Economic Production Quantities," and seeks to demonstrate that a rapid and reliable method can be developed for application to the problems most frequently encountered in planning production schedules and controlling inventories.

A paper on a similar subject, "Use of Economic Manufacturing Quantities," by Robert W. Kent, describes obstacles encountered in introducing mathematical formulas for lot sizes, manufacturing quantities, and similar elements of production. The author points out methods for determining how much of a given item is to be manufactured in one lot or at one time, and also discusses what is meant by economic manufacturing quantities and the value arising from their application to any industry.

Harold S. Falk presented a paper entitled, "Suggestions for Encouraging Education and Training for Industry" which advocates that the A.S.M.E. support a movement for the revival of apprenticeship and industrial training by staging contests, exhibitions, and doing similar work.

A paper describing the organization and management of service departments in a large plant with over 6,000 employees doing a great variety of unstandardized work of fluctuating volume was presented by William B. Ferguson and Tom H. Blair. The paper is entitled "Management of Service Departments—Budgeting and Wage Incentives Applied to a Large Organization," and describes methods used in the Newport News Shipbuilding and Drydock Company's plant. The methods described are the result of preceding study and preliminary work for over a year and represent the simplest forms of wage incentive that seemed practicable to apply to a large plant of this character.

"Present Practice in the Use of Cutting Fluids" is the progress report of the sub-committee on cutting fluids of the special research committee on the cutting of metals. The report is an attempt to indicate, in so far as its scope will permit, either the trend or lack of trend, as the case may be, toward the use of a particular type of cutting agent for a given machining operation on a given kind of metal. It is based on information obtained from 68 of the largest users of cutting fluids in this country.

* * *

Capitol Chosen For Epochal Business Meeting

Representatives of 32 manufacturing and distributing groups, including practically all branches of national business, will meet at the headquarters of the Chamber of Commerce of the U. S. on Thursday, Dec. 5, to consider, at the request of President Hoover, measures looking to the maintenance of business activities at their present high levels. Approximately 200 business men occupying key positions are included in the group, among them Carl A. Johnson, president of the National Machine Tool Builders' Association; John E. Edgerton, president of the National Association of Manufacturers; and Harold C. Smith, president of the National Metal Trades Association. A number of executives of major machine-building and metal-working plants will be in attendance also. These men will act as spokesmen for their branches of industry, and will review conditions for the group. Ways and means will then be planned for charting the way for business.

* * * *

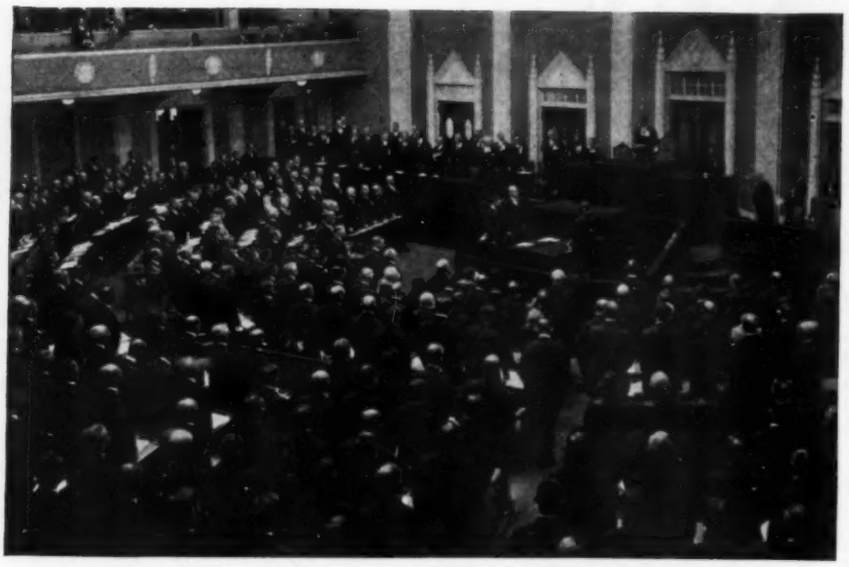
Summing Up the World Engineering Congress at Tokyo

By Fred H. Colvin

McGraw-Hill Editorial Representative at the Congress

LOOKING back on the World Engineering Congress, one is staggered by the immense amount of labor involved in working out the detailed plans and in putting them into effect. With nearly 800 papers to be presented, it is not surprising that preprints were not available in all cases. We have many meetings at home with comparatively few papers, where the same condition exists. Abstracts, bound in a single huge volume, were, however, available. Many felt that papers should be presented by title only. Or that, at most, the author or the secretary should outline the salient points in from two to five minutes. For after all, it is difficult to discuss a paper intelligently unless it has been read previously and the papers themselves are available in printed transactions, so that the real value lies in getting the experience of others on problems of interest.

There was criticism in some quarters of the contents of a few papers, particularly those on industrial management, which it was claimed, presented as new certain facts and methods of procedure that date back to Taylor. As these came, however, from countries



Prince Chichibu opening one of the Sessions of the Congress

in which mass production is only beginning and where scientific management may be called a new art, it is possible that similar ideas may have been evolved independently or that the papers were prepared with their effect on home conditions as the primary object.

The World Power Conference loomed large in the proceedings of the Congress as a whole, for is not power, and power in increasing quantities, the keynote of industrial progress? And while many of us have little direct interest in the generation of power, the cost of its generation and its supply when and where wanted is of vital importance. The great rivalry in power generation seems to be between the steam turbine and the Diesel type of engine, with the Diesel having many advocates as the coming method. Some, in countries where coal exists in quantity, are advocating the use of powdered coal in place of oil in engines of the Diesel type. The proposal is to locate the power plants near the mines so that much of the fuel that is too fine to be shipped away from the mine economically can be used as fuel at the mine itself. This is simply another phase of the proposal of 30 years ago to locate steam plants at the mines. It has the advantage, however, of requiring only enough water for cooling the engines instead of enough for condensers in plants of the old type.

A notable feature of the Congress was the interested attendance of the Japanese engineers and students. All sessions of all sections seemed to be of nearly equal interest, the whole attitude of the students indicating a desire to absorb as much information as possible from nations in which industry had gained a stronger foothold. With such interest and attention evident on every side, some of the astonishing progress of Japan becomes more easily understandable.

Aside from the engineering value of the meetings, there were many reunions of friends from all parts of the world. Many Japanese and Chinese have studied in both America and Europe and the Congress made a good meeting place. English-speaking professors who are teaching in Oriental universities were also in evidence to show how the teaching and acquiring of knowledge helps to give us the other fellow's point of view.

Hospitality was shown on every hand and to the *n*th degree. If, as is proposed in some quarters, the next World Congress goes to Chicago in 1933 at the time of the projected Fair, those who are engineering the Congress should waste no time in laying plans for the housing and entertainment of guests, especially those from distant parts of the world. Tokyo has been limited in hotel facilities and some have had to stay in Yokohama. But when it comes to providing entertainment, princes and barons have opened their homes and gardens and given us all an insight into Japanese architecture, landscaping, floriculture, plays, dances, singing, and refreshments. Those who will be charged with entertainment at Chicago should appreciate fully the task that lies before them if they expect to approach the standard set by Tokyo.

The proposal of Dr. Stan Spacek of Prague to secure a resolution for the formation of a World Engineers' Federation stirred up considerable discussion. Some advocated it in the belief that the more world-wide engineering ties can be made, the better for world advancement toward peace.

* * * *

President Hoover Leads the Way—Storage Space Curtails Auto Production—A Barge Line to Mexico—Business and Russian Recognition

By Paul Wooton
Washington Correspondent, American Machinist

WASHINGTON, D. C., Dec. 4.—Abundant evidence already is manifest that business has been cheered by the President's proposals to reduce taxes and to stimulate the building of public works and other large construction.

An important portion of the population has paid the penalty that has been meted out again and again through the years to those who thought prices would continue to go up. One result has been to bring home to them that the only thing that adds to wealth is hard work. The President moved promptly to save them and the rest of the public from the disturbances which have formerly followed the bursting of great bubbles.

Automobile manufacturers were able to convince the President that their accumulated stocks have not reached dangerous proportions. This is hailed as a victory for business statistics. A "joy-killer" took exception, saying that it was not the foresight of the manufacturers that curtailed automobile production, but the bulk of the automobile. The 300 sq.ft. that an automobile occupies in a storage warehouse costs money. The growing size of that item was a more effective warning, according to that contention, than the statistics.

In order to secure routing over the Federal Barge Line of some of the heavy industrial exports, including heavy machinery and parts, from Mid-Western cities to Mexico, C. E. Becker, assistant traffic manager of the Inland Waterway Corporation, has been instructed to go to Mexico City to discuss the matter with Mexican officials.

With the renewed attention being given export trade, there has been a sharp increase in the pressure from business quarters to recognize the present government in Russia. With its vast population of white people and its great natural resources, Russia is seen as a great potential market with a present trade of attractive proportions. The question is being asked with increasing frequency: "With European countries cultivating Russia assiduously, can we afford to hold aloof indefinitely?"

What has been characterized as a move to get into Russia by the back door has been advocated by Senator Royal S. Copeland of New York. In the form of a resolution Senator Copeland has brought forth the suggestion that the United States appoint a diplomatic representative to the Ukrainian Republic, which at present is part of Soviet Russia.

Metal-Working Industry's 1929 Operations Parallel in First and Last Quarters

By R. M. Davis
Statistical Editor, McGraw-Hill Publishing Company

IN LINE with practically all business and industry, the near future outlook in the metal-working industry is somewhat uncertain. The industry as a whole will probably be influenced to a certain extent by the present unfavorable psychological atmosphere, in the opinion of members of The Council on the Trend of Business, sponsored by *The Business Week*, which is composed of 5,600 top executives in all lines of business and industry, of whom about 975 are directly interested in the manufacture and distribution of metal products. Considering the metal-working industry as a whole, these business men indicate that the volume of business at the close of November was on a plane about 8 per cent below that at the close of October, and at about the same level as at the close of November last year. Looking into the near future these men indicate that they expect an average volume of business during the next 90 days of about the same proportions as that prevailing at the close of November, but of proportions about 3 per cent under that during the same 90-day period last year. In other words, manufacturers and distributors of metal products believe that operations in their industry have reached a point of stability which should continue throughout the winter months. They do not expect the downward trend witnessed during November to continue.

Taking the two leading branches of the metal-working industry—automobile manufacture, and all other branches except railroad repair shops—varying tendencies and expectations are indicated. The volume of business at the close of November in the automobile industry, including the manufacture of parts and accessories as well as distribution of cars, was on a plane about 9 per cent below that at the close of October, and about 3 per cent under that at the close of November last year. The volume of business in other branches at the close of November was about 8 per cent lower than that at the close of October, but was still of proportions about 1 per cent higher than that at the close of November last year.

The members of The Council intimately connected with the operations of the automobile industry expect to do an average volume of business during the next 90 days about 5 per cent over that existing at the close of November, this expected improved business being largely the result of many new models currently announced. These members of The Council indicate, however, that this expected average volume of business during the next 90 days will still be of proportions about 5 per cent under that witnessed during the same period last year.

The other branches of the metal-working industry expect to do an average volume of business during the next 90 days about 2 per cent under that at the close of November, and of proportions some 2 per cent under that during the same 90-day period last year.

Three outstanding events stand out as the dominating favorable influence in the present business situation. First is the return of stock market to normal levels. The stock market adjustment has sent business men, big and little, back to work.

The second favorable factor is the bringing into co-operative action of the business and industrial powers of the country by President Hoover through a series of conferences with business leaders. The sound construction plan announced by these conferences will go far in turning the thinking of the general public into a higher channel. People have great confidence in the ability of the President to solve the pressing problems of business and industry, and will hold much of the latent pessimism as to the future in check pending the outcome of the President's efforts to guide the economic flow.

The third favorable factor is the return of the money market to normal channels, both as to rate and distribution for legitimate borrowers. General construction, together with business and industrial expansion, should be materially enhanced during the next few months due to ability to obtain money at reasonable rates of interest.

On the unfavorable side the outstanding influence is the prevailing feeling of uncertainty and fear as to what the future may hold. That the effects of the stock market deflation, however, will be temporary, is generally regarded as certain. There is without doubt some actual decrease in the buying inclination of a fraction of the public which hit luxury articles first and hardest, but there will be little effect on the real purchasing capacity of the ultimate consumer.

* * *

Pipe Machine Builders In $2,000,000 Merger

A $2,000,000 merger of pipe machinery manufacturers was announced recently involving the Oster Manufacturing Co., Cleveland, and the Williams Tool Corporation, Erie, Pa. Both concerns will retain their corporate identity, with Roger Tewksbury acting as operating head of the combined companies. The Oster Co. produces adjustable pipe-threading tools. The Williams Co. manufactures a line of standard pipe machines, pipe-cutting machines, and both single- and double-spindle bolt machines.

The Oster Co., a pioneer in the export field, was formed in 1893 by Herman W. Oster and Russell B. Tewksbury. The officers at present are: R. B. Tewksbury, president; Roger Tewksbury, vice-president and treasurer, and Arthur S. Gould, secretary. The Williams Co. was founded in 1901. Its officers are: Horace W. Davis, president; E. P. Poole, vice-president, and J. E. Humble, secretary-treasurer. Roger Tewksbury will succeed Mr. Davis as president.

* * *

REQUESTS for acceptance of the simplified practice recommendation for full-disc buffing wheels are being issued by the Bureau of Standards of the U. S. Department of Commerce to users, manufacturers, and dealers of buffing wheels. Copies of the recommendation may be obtained by addressing the Bureau of Standards, Washington for Bulletin R115-30.

* * * *

Four and One-Third Years Without a Reportable Injury!

Four and one-third years is a long time for 27 men in one department to work for a railroad without some of them suffering reportable injuries. This group of 27 members of the air brake department, Emerson Shops, the Atlantic Coast Line Railway, have made that record. W. M. Cavin is foreman of the group

BUSINESS · BAROMETER

Winter of peaceful activity and Spring of good business expected as a result of President Hoover's conferences

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

THERE is much to indicate that the public attitude toward political economy and political economists is changing. This is certainly true of Great Britain and the United States, and those who know Germany well insist that she, too, is becoming less concerned about her military prowess. Hence it is that America and Western Europe now faces the possibility of a profound change in their politico-economic status. In Germany, the recent success of the Berlin Socialists at the polls cannot be disregarded. In Great Britain, the present Labor Ministry is committed to a plan for the acquisition and operation of the coal mines that may be revolutionary in its economic effect. If it is successful, it may be followed by the adoption of a similar plan for the acquisition of the cotton manufacturing industry of Great Britain.

In the United States, President Hoover has called a lot of our business men into conference. His object has been to obtain their assurance that they would go on with the development work they have planned despite the reaction in the stock market; the idea being that continued employment at good wages would avert the depression which the decline in stocks threatened to bring about. He likewise proposes to establish permanent councils whose aim shall be to influence business policies so that extreme ups and downs may both be averted.

From this brief summary of the plans that are under consideration, it will be seen how much depends on their success. If it shall prove possible to arrest the business cycle and prevent the occasional depression which has hitherto been felt with regular irregularity, then science will have achieved a great victory over human nature. Formerly, it was assumed that work made rest essential, and that quietude was a sequence, if not a consequence, of activity. The new philosophy of economics that is being urged upon the world of industry and business assumes that a normal pace can be maintained at all times, and that the wheels of enterprise can be kept revolving at a speed that is neither too fast nor too slow by controlling the expenditures made for extension and new construction.

There is much that is plausible in this theory. The one difficulty in the way of its general acceptance is psychological. People are not yet quite willing to believe that man-made prosperity is possible, but they are ready to be convinced, and if President Hoover's conferences shall re-imbue the business men of the country with confidence in the future, we shall probably see a winter of peaceful activity and a spring of good business.

This is about all that can be said of the present outlook.

From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

OPTIMISM is the prevailing note in machinery and machine-tool markets of the country. Beyond the usual year-end slowing up, there has been litle evidence of a decline of any sort. Most centers report that exhausted or depleted budgets have caused some delays in closing orders. These delays are expected to be cleared up with the coming of the new year and the issuance of budgets for 1930. Smaller plants are busy taking inventory, this having also affected the market to a small extent. Generally, however, conditions are better than they were at this time last year, and President Hoover's industrial conferences seem to have overcome any hesitancy which might have existed among prospective purchasers. Deliveries are improving slowly, but are still poor. Prices are the same, with the exception of prices of two lines of shapers, which were raised 10 per cent.

PHILADELPHIA reports good railroad business during the week. New York railroad electrification and improvement programs have begun to be carried out, and preliminary purchases of tools are being made. The New England demand for November did not equal that of October, but was still better than normal. Cincinnati sales were of single tools to a widely diversified field. Conditions in Detroit are showing marked improvement. Chicago business is experiencing the usual seasonal decline. The Cleveland market is spotty. Milwaukee inquiries have increased considerably.

Business for the week ended last Saturday was relatively quiet. The Stock Exchange is just getting itself straightened out morally as well as mathematically. Confidence seems to have been re-established, but the majority of people are still cautious.

In the commodity markets, there has not been much change. The decline in steel-mill activity and the reduction in the demand is overstressed, chiefly due to the decrease in the buying of the automobile manufacturers. This, however, is not likely to be permanent. In November, the output of motor cars was the lowest in almost two years, but December will bring increased production of new models. After opening 1930 cautiously, the industry will soon begin to speed up.

The market for raw cotton has been quiet. The fluctuations have not been important or significant. The crop is conceded to be close to 15,000,000 bales, and whether consumption will fall short of or exceed that figure sufficiently to change the price, much remains to be seen. Coffee is still weak, although it is a little steadier than it was. Brazil has obtained a short loan to ease her financial strain but she is not moving her huge stocks rapidly enough to help much. Sugar is steadier again after a sinking spell, but supplies are still excessive. Grain seems to be about as high as the attitude of the Federal Farm Board justifies, and it is expected that the large elevator stocks will be gradually worked off at present prices.

In Europe, the situation is satisfactory and encouraging. The only sore spot abroad seems to be in China, and it is fairly possible that the irritation aroused may be allayed by the friendly intervention of our government.

The failure of Congress to enact any tariff legislation has not had much effect upon our internal trade. There were but few who expected any radical changes in the old duties, and the new political alignment makes it doubtful whether we shall see any important revision of the present schedules soon.

Speaking generally, the outlook would seem to be satisfactory, unless we take it too seriously. And while we wait for the public to register its response to President Hoover's new political economy, we may look forward with confidence to a future that now seems to include very few disturbing factors.

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THE INDUSTRIAL REVIEW

Weekly progress of the machinery and machine-tool business

THE following reports, gathered from the various machinery and machine-tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

PHILADELPHIA

An optimistic feeling concerning the future prevailed among machinery and machine-tool dealers, manufacturers, and sales agents throughout the Philadelphia area this week. This was born of a condition which was regarded as unusually favorable, with some substantial orders from two railroads, some purchases by the automotive industry, continued activity among producers of industrial machinery, and an inflow of inquiries which not only were numerous, but which bore hopeful indications of purchases.

One of the largest producers of machine tools in this area reported the sale of heavy tools to a Mid-western railroad and a similar purchase by one of the Eastern carriers. This same company's representative said there had been no indication of a let-up in activity, and it had received inquiries from industrial establishments seeking prices on various equipment.

Two automobile manufacturers placed some medium-sized orders with one of the Philadelphia manufacturers, and these, together with some purchases by the Rayon Silk Co. places on one company's books orders sufficient to keep the plant in operation for one year. Other companies reported that there are some active propositions now under consideration which are developing satisfactorily.

Manufacturers of bearings reported some activity among industrialists, with some buying from the automotive trade. Manufacturing plants generally are operating up to 60 per cent of capacity, and in some instances, operations are greater than that figure. There has been little reflection in this market of the recent stock market slump.

NEW YORK

Railroad buying continued to be the predominating feature in the New York machinery and machine-tool market during the week. The indirect demand for machine tools resulting from the placing of the huge railway orders for equipment is expected to influence business in the near future, and actual railway buying is reported by several dealers. The New York Central is placing orders for machine tools upon which inquiries were made a year ago, and has also released a number of orders and contracts in connection with the change in the signalling system and the 4-track development. The Pennsylvania is expected to allot in the near future the first of the $40,000,000 worth of passenger and freight locomotives which will be purchased in connection with the electrification of that railroad from New York to Washington. The entire project is expected to cost $100,000,000, and 375 to 400 locomotives will be bought for it at an estimated cost of $100,000 apiece.

According to dealers, the machine-tool market has shown little tendency to slack below the purely seasonal let-down which occurs each year when the inventories of smaller companies and the depleted budgets of larger companies begin to worry prospective purchasers. Two lines of shapers have been raised 10 per cent in price. Another intended price change was cancelled, but outside of that, no price changes are anticipated in the near future. Deliveries are improving slowly, although there is little evidence of any real improvement as yet. The automobile equipment and aircraft manufacturers are almost entirely out of the market, but their place has been taken by a number of small miscellaneous buyers who are boosting the total sales value to its previous levels. Little change in the situation is expected before the first of the year, but the anticipated budgets for 1930 are expected by dealers to bring them a slightly delayed Thanksgiving.

NEW ENGLAND

The November demand for machinery and machine tools, according to transactions noted in the New England territory, did not equal the October demand, but was better than normal. Builders have felt the results of the lighter demand from the automotive field. There have been no reports of cancelled machine-tool orders, however, and only small-parts manufacturers and jobbing shops have had orders held up. Some dealers did a better business in November than in October, but this was by no means general. All in all, the month was up to expectations, since a let-up is usually anticipated during the last months of the year. The current week developed little change. Orders were for a scattered variety of machines with small units predominating.

Industrial schedules continue to be well-balanced and the output of products is in line with that of other months of the year. Construction engineers throughout this section find little or no indications of a building depression and most offices are preparing plans for a high total of industrial construction. It is noteworthy that this business barometer gives a most optimistic outlook.

Preliminary work has been started at Bucksport, Me., for a $10,000,000 paper plant for which equipment is desired. The New England Power Association, Boston, plans to spend $29,000,000 on power projects during 1930. The New York, New Haven & Hartford Railroad Co. will purchase 10 electric locomotives and 33 multiple passenger cars provided for in an additional appropriation of $3,500,000 announced this week.

CINCINNATI

Machine-tool manufacturers in the Cincinnati district report that, as a result of the Thanksgiving holiday, the sales total of the past week was proportionately less than that in the previous week. At this time of the year, it is pointed out, there is nearly always a market recession, not as a result of unfavorable business conditions, but because there is a tendency to postpone the making of commitments until new budgets are prepared.

Taking the trade as a whole, the first 11 months of this year have shown a large gain, as compared with the same period of the previous year. Looking into the future, it is thought that business will continue at about its present level through the present month, after which the sales curve will begin to ascend.

The great majority of the orders booked in the week were for single tools, well scattered as to source and well diversified. The principal buyers were general machinists and miscellaneous users. The week's inquiries were largely confined to single tools and replacements and the great majority of them came from small users, located in all sections of the country.

Selling agents report that in spite of the holiday they had a very good week. Users of machine tools in this vicinity are busy, and signs are seen of an increased demand in local and adjacent territory.

Machine-tool manufacture continues as it has been, with no decrease of employees nor curtailment of output.

DETROIT

The market for machinery and machine tools has shown a marked improvement within the past ten days, but it is still irregular and below the level of that of the early fall. Several dealers have received large orders for production equipment.

There has been a change in the general atmosphere here, accompanied by a noticeable stimulation of industry and trade. The automotive industry has advanced from its extreme depression and there are indications of a continued forward movement. The orders for machinery and equipment that have been received from the automobile manufacturers indicate a returning optimism and have probably been influential in changing the tone of the entire business outlook here.

Throughout the state, the automobile and accessory manufacturers are making plans for increased production. Employment, which was at an extremely low level, has advanced considerably within the past two weeks and there are indications of still further improvement this month.

In general, it is believed that the market for machinery will be substantially improved in January or February.

CHICAGO

Business in the machine-tool industry has slowed up and the consensus of opinion is that there seems to be little probability that it will show much improvement until the new year. While inquiries have been received in fairly good volume, they have not been followed up, and those submitting them for the most part have decided to await further developments before placing their orders. The statements of some of the leading industrialists, noted a week ago, to the effect that they had not even considered halting their activities in any degree had an encouraging effect on the trade, and the announcement made by railroad executives that their roads proposed spending a billion dollars during 1930 for equipment had a further tendency toward creating optimism. As one man put it, if but two or three per cent of this amount should be expended for shop equipment, it would have a marked effect in stimulating production by machine-tool builders. Buying at this time is mainly confined to the Chicago territory, and is principally for equipment required. The C. & N. W., and the C. M. St. P. & P. railroads within the last week submitted lists calling for several units for their shops.

CLEVELAND

Although the local machine-tool market continues to be spotty and dull, the industry is looking forward to the expected releases of shipping specifications from the automobile and parts manufacturers for an upward trend in sales. A considerable

number of Cleveland industries are expected to receive sizeable orders as soon as the 1930 automotive schedules are made out. Locally, the trade is anticipating immediate action from this source on inquiries which have been held in abeyance for some time.

Machinery firms are not expecting any depression in the near future. Excluding the holiday season and inventory time, it is expected that the first quarter of the new year will show increased activity. Only a few orders for tools have been cancelled. One producer has suffered only one small order cancellation, while on the same day he received an order which was larger than the one cancelled.

A leading manufacturer of automatic machinery has $1,500,000 worth of orders ahead for December, with inventories at a low point. This plant is running about 75 per cent of normal or around 35 per cent under the peak. Another manufacturer of electric machine tools used extensively in the automotive field states that their line in sales is holding up satisfactorily with their plant running about normal capacity and with payrolls near the peak.

MILWAUKEE

Inquiries for machine tools have been greatly increased and although sales have dropped off as compared with those of the recent rush period, pending business is being closed without unusual difficulty, and the only reported delays are being sought by the automotive manufacturers. Deliveries have been greatly improved in some instances, but manufacturers of machine tools with old, established markets state that their back-logs have not been reduced appreciably. Salesmen report that customers who take inventory in December are pleading that as an excuse for delay.

Nearly all of the large metal-working plants are continuing production at a steady rate, which can be described as above normal. In some lines, output is being materially increased, notably so among the manufacturers of machinery and equipment for power generation and conveyance and of appliances for dirt handling and snow removal. Automobile production, while still under normal is being stepped up slowly. Early advance orders for agricultural implements continue to indicate resumption of full-time schedules in the implement plants. Although farm tractor production has dropped, there is no great let-up in the manufacture of heavy duty tractors. Sheet-steel production continues at full capacity and will be maintained at that point until the end of the year.

BUFFALO

The machine-tool trade in the Buffalo district is slow. Inquiries are somewhat spotty, but optimism is pronounced. Conditions are considered normal for this season of the year. The electrical equipment field is also comparatively quiet, although there are some important inquiries for next year. It is reported that the Buffalo, Niagara & Eastern and others of the Niagara-Hudson power group are planning large capital expenditures during the coming year, chiefly for substation equipment.

* * *

Lamson-Erie Merger Plans Effective Dec. 1

Final steps in the merger of the Lamson & Sessions Co., and the Lake Erie Bolt & Nut Co., Cleveland, were completed recently with the organization of the board of the merged company. J. G. Jennings became chairman of the board as F. C. Case, a member of the company for 40 years, retired as chairman to become a member of the board. George S. Case was elected president, and N. J. Clarke, former president of the Lake Erie Co., became vice-president and chairman of the executive committee. Charles L. Wasmer retired as a director. Other officers include: Roy H. Smith, vice-president and director of operations; I. L. Jennings, vice-president and director of sales; C. H. Longfield, secretary and sales manager; and H. E. Volmar, former secretary of Lake Erie, treasurer. H. A. Keske is controller. All appointments were effective Dec. 1.

* * *

Auto Industry Employs 4,000,000 Workers

According to figures released by the National Automobile Chamber of Commerce, there were approximately 3,956,138 workers directly employed in the automobile industry in this country in 1928, and 385,000 indirectly employed. Directly employed workers include 1,500,000 drivers, 635,000 chauffeurs, 402,138 factory workers, 365,000 dealers and salesmen, 300,000 repair shop employees, 200,000 parts and accessories factory workers, and smaller numbers of accessories and parts dealers and salesmen, garage employees, gasoline refinery workers, tire factory workers, and auto financing and insurance men. Those indirectly employed include 100,000 highway officials, contractors, and engineers, 96,000 railway workers, and 86,000 iron and steel workers.

* * *

Floyd K. Smith to Head Donner Steel Company

Directors of the Donner Steel Co., Buffalo, control of which was acquired recently by Continental Shares, Inc., Cleveland, recently elected Floyd K. Smith president of the company and its subsidiaries, the Donner Steamship Co., and the Donner Ore Co. Mr. Smith will succeed William H. Donner, who announced his resignation from the presidency a few days ago. Mr. Smith has been vice-president and treasurer of the company for the past 11 years. The directors also elected W. W. Hancock, former secretary, as vice-president to succeed Mr. Smith.

* * *

Milling Cutter Standard Suggested by A.S.M.E.

Copies of a suggested American standard for milling cutters were distributed to members of the sectional committee on the standardization of machine-tool elements of the A.S.M.E. for their criticism prior to a vote taken on Dec. 4. The present suggested standard is the result of the committee's original work, together with suggestions made by industry after a preliminary distribution of proof sheets in January. The suggested standard lists nomenclature, diameters, thickness, and other important dimensions. Sponsors of the proposed standard are the N.M.T.B.A., the S.A.E., and the A.S.M.E.

Business Items

The Pines Winterfront Co., Chicago, has moved its "built-in" department to the new plant at Cicero Ave. & Division St. The new plant provides 200,000 sq.ft. of floor space on two floors. Presses and other heavy machinery are on the first floor, and enameling, plating, and assembling are done on the second floor. Engineering and general offices, and the experimental laboratory are also on this floor.

The Hevi Duty Electric Co. has moved into new and larger quarters at 4100 Highland Blvd., Milwaukee, Wis. The building will provide double the present productive space and is especially equipped for building furnaces and furnace equipment. Crane facilities are provided. Space has been reserved in the building for laboratory and development work.

The Steel Trough & Machine Co. Ltd., Tweed, Ont., has purchased property in Hamilton, and intends to erect there a factory for the manufacture of all kinds of steel equipment. They have installed machinery in a building on the property and will carry on operations there until the new plant is completed.

The Albertson Manufacturing Co., Sioux City, Iowa, has added a complete line of electric tools to its equipment. lines. The company plans expansion of the plant during the next year which will double its floor space, according to Harold Jacobsen, vice-president and secretary.

The Bosch Magneto Corporation, Springfield, Mass., is building an addition to the present "A" plant on North Main St., Springfield. The building is of the saw-tooth type, two stories in height, and will house the heat-treating and hardening rooms, a sand-blasting room, a department for scrap reclaiming, store rooms, and the shipping department when completed.

The Detroit Alloy Steel Co., Detroit, Mich., has opened an eastern district office for the distribution of PRK-33 patented "Cobaltcrom" air-hardening tool steel castings. Wm. C. Eakin has been appointed eastern district sales manager, with offices at 707 Berkshire Ave., Pittsburgh, Pennsylvania.

The L. Newman Tool, Die & Machine Works, Alameda, Calif., recently moved into a new steel and brick building. The shop force has been increased.

The E. I. Dupont de Nemours Co., Wilmington, Del., has awarded the Austin Co., Cleveland, a contract for the design and construction of a $75,000 machine shop. The shop will be one story, 90 by 197 ft. Eighty-five tons of structural steel will be used.

The Hill Equipment Engineering Co., with offices at 4620 Delmar Blvd., St. Louis, has been organized by Lockwood Hill, for the past 10 years a member of the Blackman Hill Co., St. Louis. The new organization will have the

exclusive agency for products of the Lincoln Electric Co., Cleveland, and the Baker Industrial Truck Co. for the St. Louis district, including the Eastern Missouri and Southern Illinois territories.

Thomson Products, Inc., Cleveland, Ohio, is establishing a branch plant in St. Catherines, Ontario, for the manufacture of valves and other products. The company is building a two-story factory with a space of 25,000 sq. feet.

The Fish Machinery Corporation, manufacturer of machinery for use in the fishing industry, has been incorporated in San Diego, Calif., by Wilson S. Smith and Fred E. Lindley of San Diego and Frank E. Rose of Los Angeles.

The Lincoln Products Corporation, 31 Fulton St., Newark, N. J., has been appointed distributor for the Lewis-Shepard Co., Boston, Mass., in Northern New Jersey.

The Boiler Tank & Pipe Co., Oakland, Calif., recently moved into a new all-steel plant occupying a ground space of 70x600 ft. P. W. McDonough is manager and owner.

The Grey Hub Co., Detroit, is moving into the new plant at 17265 Gable St. Approximately 6,000 sq.ft. of space will be contained in the new plant.

The Hahn Foundry Co., 804 Renkert Building, Canton, O., was recently incorporated.

Personals

S. C. Vessy, president of the W. W. Sly Manufacturing Co., Cleveland, Ohio, has been elected a director of American Foundrymen's Association to fill the vacancy caused by the death of H. Cole Estep. His election was performed by letter ballot of the remaining directors. Mr. Vessy served once before as a director, from 1926 to 1929.

Leonard S. Horner, president of the Niles-Bement-Pond Co., and chairman of the U. S. Department of Commerce Special Advisory Committee on the Census of Manufactures, spoke to the conference of community representatives of industry at the Pennsylvania Hotel, N. Y. on Nov. 22 on "The Census Bureau Meets New Tempo of Business."

Theodore R. Gerlach, vice-president and general manager of the Joliet Wrought Washer Co., and president of the Gerlach-Barklow Co., Joliet, will be installed as president of the Illinois Manufacturers' Association on Dec. 10 at a meeting in the Hotel LaSalle, Chicago.

F. P. Mullins, vice-president, secretary, and treasurer of the Mullins Manufacturing Corporation, Salem, Ohio, resigned on Nov. 12 to become a partner in the A. E. Masten Co., Pittsburgh. W. P. Carpenter was elected treasurer and Clifton Reeves was elected secretary to fill the vacancies left by Mr. Mullins. S. J. Watkins was made assistant secretary, and R. F. White a director.

W. H. Eisenman, secretary of the A.S.S.T., 7016 Euclid Ave., Cleveland, and director of the National Metal Exposition for the past 10 years, has been elected president of the Association of Exposition Managers for the third successive year.

Roger Tewksbury, vice-president and treasurer of the Oster Manufacturing Co., Cleveland, has become president of the Williams Tool Corporation, Erie, Pa., as a result of the merger of the latter company with the Oster Company. He succeeds Horace W. Davis.

C. E. Pioch, formerly general master mechanic of the Chrysler Corporation, has joined the staff of the Seneca Falls Machine Co., Seneca Falls, N. Y. He will spend most of his time contacting with production plants in the field.

John M. Manley, secretary of the Cincinnati Metal Trades Association, who formerly had offices in the Odd Fellows' Temple, has moved his offices to the First National Bank Bldg., 318 Walnut St., Cincinnati.

Frank W. Fry has been appointed New York district manager for Hausman & Wimmer Co., Pittsburgh. His headquarters are at 11 West 42d St. Mr. Fry has been affiliated with the company since last July.

C. S. Williams, Jr., vice-president, Thomas A. Edison, Inc., has accepted the chairmanship of the ways and means committee of the American Fair Trade Association.

E. L. Caswell, export manager of Thompson Products, Inc., has been appointed a member of the International Trade Committee for 1930 by the National Standard Parts Association.

Obituaries

Louis Duffke, secretary-treasurer and one of the founders of the Nortmann-Duffke Foundry Co., Milwaukee, died Nov. 18 at the age of 66 years. He was born in Milwaukee and had established the foundry company in 1890 in collaboration with the late Val. Nortmann.

Thomas J. Fay, president of the Fay Metal Patch Co., Cleveland, died at Greensboro, Ala., on Nov. 22, when driving to New Orleans, La. Previous to his organization of the Fay Company seven years ago, he had been associated with the White Motor Co. and the Bishop & Babcock Company.

Forrester B. Leslie, 51, well known in the iron and steel trade of both the United States and Canada, died at his home in Montreal on Nov. 21. Mr. Leslie was director of A. C. Leslie & Co., Ltd., Montreal. Born in Montreal in 1878, son of the late Alexander C. Leslie, founder of the Leslie firm, Forrester B. Leslie received his education at the Montreal High School. Upon leaving school he entered his father's office, devoting himself to the iron and steel trade. He was associated with the American Iron and Steel Institute.

Frank A. Hunter, Sr., 57, president of the Hunter Saw & Machine Co., Pittsburgh, died on Nov. 19 in that city. With his brother, Harry S. Hunter, he organized the company in 1898, incorporating it in 1905. He held the position of secretary and treasurer until 1925, when he became president after the death of his brother. He had been active in business until two years ago.

Clem H. Kroger, Jr., 32, secretary and treasurer of the Precision Tool Works, Cincinnati, died at his home in Covington, Ky., on Nov. 19, after a long illness. He was also secretary and treasurer of the Highland Products Company.

John P. Gundlach, 64, associated with George N. Gundlach in the P. M. Gundlach Co., Belleville, Ill., died Nov. 12 at his home in Swansea, Illinois.

Charles W. Baker, 60, president of Baker & Co., Inc., Newark, N. J., died on Nov. 16 after a brief illness. Mr. Baker had succeeded to the vice-presidency in 1918, after the death of his brother.

J. H. Hollinger, Philadelphia representative of the Landis Tool Co., Waynesboro, Pa., died on Monday, Nov. 18.

Forthcoming Meetings

American Society of Mechanical Engineers — Annual meeting, New York, Dec. 2 to 6. Headquarters will be at 29 W. 39th St., New York City. Calvin W. Rice is secretary.

Power Transmission Association—Annual Meeting, Hotel Commodore, New York City, Wed., Dec. 4, 10 A.M. through luncheon. W. S. Hays, 644 Drexel Bldg., Philadelphia, Pa., is secretary.

Taylor Society — Open meeting, Dec. 4, 5, and 6. Hotel Pennsylvania, 7th Ave. and 33rd St., New York City. The Society offices are at 29 West 39th St., New York City.

Steel Founders' Society of America—Regular meeting, Pittsburgh, Pa., Dec. 12. Details may be obtained from the executive offices, 932 Graybar Bldg., New York City.

American Engineering Council—Annual Meeting, Washington, D. C., Jan. 9 to 11. L. W. Wallace, 26 Jackson Place, Washington, is secretary.

THE WEEKLY PRICE GUIDE . . S

Rise and Fall of the Market

WITH mill operations at 69 per cent of capacity, against 83 per cent a year ago, there is no marked demand for any of the principal hot-rolled steel materials, except plates for freight-car construction. Business in automotive, line-pipe, ship and tank plates is light. The Pittsburgh base of $1.90 per 100 lb. on plates, however, is being carried over into the first quarter of 1930. Shapes remain in fair demand at $1.90, the October level. Tin and antimony recovered in spots this week, while the decline which has characterized non-ferrous metals recently, continues in zinc and scrap.

(All prices as of Nov. 29, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$17.69@$18.19
Northern Basic	19.90
Southern Ohio No. 2	19.90
NEW YORK—Tidewater Delivery	
No. 2 Southern (silicon 1.75@2.25)	19.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	14.00@14.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76@22.26
Virginia No. 2	24.04
Basic	19.75@20.25
CHICAGO	
No. 2 Foundry, local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	20.01
PITTSBURGH, including freight charge ($1.76) from Valley:	
No. 2 Foundry	20 26
Basic	20 26
Bessemer	20.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed*	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.35	3.30	3.90†
No. 12	2.15@2.25	3.45	3.35	3.95†
No. 14	2.25@2.35	3.55	3.45	4.00†
No. 16	2.35@2.45	3.65	3.55	4.10†
Black				
Nos. 18 to 20	2.55	3.85	3.70	3.80
No. 22	2.70	4.00	3.85	3.95
No. 24	2.75	4.05	3.90	4.00
No. 26	2.85	4.15	4.00	4.10
No. 28	3.00	4.75	4.15	4.25
Galvanized				
No. 10	2.80	4.20	4.05	4.05
Nos. 12 to 14	2.90	4.30	4.15	4.15
No. 16	3.00	4.40	4.25	4.25
No. 18	3.15	4.55	4.40	4.40
No. 20	3.30	4.70	4.60	4.55
No. 22	3.35	4.75	4.65	4.60
No. 24	3.50	4.90	4.75	4.75
No. 26	3.75	5.15	5.00	5.00
No. 28	4.00	5.40	5.25	5.25

*Light plates. †Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in. butt	53.74%	41.2%	55.5%	43.5%	55.5%	42.5%
3½ to 6 in. lap	50.32%	37.78%	53.5%	40.5%	51.6%	39.0%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
⅛	$0.17	1.315	1.049	.133
¼	.23	1.66	1.38	.14
⅜	.27½	1.9	1.61	.145
½	.37	2.375	2.067	.154
¾	.58½	2.875	2.469	.203
1	.76½	3.5	3.068	.216
1¼	.92	4.0	3.548	.226
1½	1.09	4.5	4.026	.237
2	1.48	5.563	5.047	.258
2½	1.92	6.625	6.065	.28
3	2.50	8.625	8.071	.277

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

Thickness—Decimal Fractions	B.w.g. and	Outside Diameter in Inches—Price per Foot—⅛	¼	⅜	½	⅝	¾	1	1¼	1½
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23		
.049″	18	.17	.18	.19	.20	.21	.23	.25		
.065″	16	.19	.20	.21	.22	.23	.25	.27		
.083″	14	.20	.22	.23	.24	.25	.27	.29		
.095″	13	.21	.23	.25	.26	.27	.29	.31		
.109″	12	.22	.24	.26	.27	.28	.30	.32		
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33		
.134″	10	.24	.26	.28	.29	.30	.32	.34		

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.50	3.65	3.60
Cold drawn, flat or square‡	4.00	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.25†	3.00	3.00
Soft steel bar shapes	3.25†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.25	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, $\frac{3}{16}$-in. thick. †Up to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire at New York warehouse— $\frac{3}{32}$, 8.35c. per lb.; $\frac{1}{8}$, 7.85c. per lb.; $\frac{5}{32}$ to $\frac{1}{4}$, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			19.25
Tin, Straits, pigs, New York			43.00@44.00
Lead, pigs, E. St. Louis	6.10	New York	7.00@7.50
Zinc, slabs, E. St. Louis	6.00	New York	7.25@7.75

	New York	Cleveland	Chicago
Antimony, slabs	10.50@11.00	11.60	14.50
Copper sheets, base	27.75	27.75	27.75
Copper wire, mill, base	20.12½	20.12½	20.12½
Copper, drawn, round, base	26.25	26.25	26.25
Copper tubing, base	29.25	29.25	29.25
Brass sheets, high, base	23.25	23.25	23.25
Brass tubing, high, base	28.25	28.25	28.25
Brass rods, high, base	21.25	21.25	21.25
Brass wire, high, base	23.75	23.75	23.75

SHOP MATERIALS AND SUPPLIES

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25@26	24.30	24.30
Zinc sheets (casks).....	10.75@11.25	12.25	10.11
Solder (½ and ½).....	29.75	29.75	28@30
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade.....			56.00
Commercial genuine, intermediate grade.....			42.00
Anti-friction metal, general service.....			31.00
No. 4 babbitt.....			11.50

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold drawn.....	53.00	40.00
Tubing	75.00*	90.00†
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Welded.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity offered for sale:

	New York	Cleveland	Chicago
Crucible copper.....	12.25 @14.75	13.50	12.00 @12.50
Copper, heavy, and wire..	13.50 @13.75	13.00	11.00 @12.00
Copper, light, and bottoms	12.00 @12.25	12.00	10.00 @11.00
Heavy lead.....	4.37½@ 4.87½	5.25	4.25 @ 4.75
Tea lead.....	2.87½@ 3.12½	3.25	3.25 @ 3.75
Brass, heavy, yellow.....	7.75 @ 8.00	8.00	7.00 @ 7.50
Brass, heavy, red.....	11.00 @11.50	12.50	10.00 @10.50
Brass, light.....	6.25 @ 6.75	7.00	6.00 @ 6.50
No. 1 rod, brass turnings.	9.00 @ 9.25	8.00	7.50 @ 8.00
Zinc.....	2.75 @ 3.00	3.00	2.50 @ 3.00

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb..	$0.13*	$0.16	$0.15
Cotton waste, colored, per lb..	.09½*	.12	.12
Wiping cloths, washed, white, per lb.....	.12½	38.00 per M	.16
Sal soda, per lb.....	.02½	.02	.02
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.152	.164	.16
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	65	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.33	.36	.24
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt...	30%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*Grade F.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.0325	$0.0325	$0.0325
Cold drawn shafting...	per lb..	.035	.036	.034
Brass rods.....	per lb..	.2125	.2125	.1825
Solder (½ and ½).....	per lb...	.2975	.3075	.3575
Cotton waste, white...	per lb..	.13	.13	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	4.59	4.60	3.59
Lard cutting oil.....	per gal.	.65	.65	.65
Machine oil.....	per gal.	.33	.33	.30
Belting, leather, medium.....	off list..	30–10%	30–10%	30–10%
Machine bolts, up to 1x30 in., full kegs...	off list..	50-10%*	50–10%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper*.....	$6.03	$5.94	$5.94
Emery cloth*.....	25.87	26.40	26.40
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper†.....	2.61	2.61	2.61
Cloth†.....	4.59	4.59	4.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton.....		Connellsville,	2.65
Coke, prompt foundry, per net ton.....		Connellsville,	3.50@4.85
White lead, dry.....	100 lb. kegs ...	New York,	13.75
White lead, in oil.....	100 lb. kegs....	New York,	14.25
Red lead, dry.....	100 lb. kegs....	New York,	13.75
Red lead, in oil.....	100 lb. kegs....	New York,	15.25

*Less than 3 reams. †Less than 200.

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	60%
Larger, up to 1 x 30-in., full kegs, list less.....	50–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	60%
Larger, list less.....	50–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.50
Structural, round head, broken kegs, net.....	6.00
Tank, $\frac{7}{16}$-in. dia. and smaller, list less.....	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	60%
Larger, up to 3-in., list less.....	40–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$4.00
Wrought, broken kegs, per 100 lb., list less.....	2.00
Turnbuckles:	
With stub ends, list less.....	20%
Without stub ends, list less.....	50%
Chain:	
Proof coil, base, per 100 lb., net.....	$7.10
Cast iron welding flux, per lb., net.....	.40
Brazing flux, per lb., net.....	.80

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Equipment Wanted

D. C., Washington—A. L. Flint, General Purchasing Officer of the Panama Canal—will receive bids until Dec. 7, for valve grinding machines, etc.

Ind., Anderson—Anaconda Copper & Cable Co. machinery for the manufacture of wire for proposed 1 story 100 x 200 ft. factory on East 31st St. Estimated cost $40,000.

Mass., Boston—Bureau of Supplies & Accounts, Navy Dept., Washington, D. C.—machine tools, etc. at Navy Yard here.

Mich., Detroit—Artcraft Mantle & Fireplace Mfg. Co., 6315 East Seven Mile Rd. (manufacturers of metal and fireplace fixtures)—shaper.

Mich., Detroit—A. J. Bopp, 4-237 General Motors Bldg.—rolling equipment for strip steel for proposed 1 story, 60 x 400 ft. factory for the manufacture of cold rolled sheet steel. Estimated cost $75,000.

Mich., Detroit—Findley Tool & Die Co., 5680 12th St.—miscellaneous machine shop equipment.

Mich., Wayne — Detroit Aircraft Corp., 115 Campau Ave.—machinery and equipment for the manufacture of planes and accessories for proposed 1 story airplane factory on Van Born Rd. Estimated cost $75,000.

Mo., Valley Park—Barbour Metal Boat Works ½ in. power punch, and ⅜ in. power splitting shear, rotary preferred.

N. J., Newark—Bd. of Education, 31 Green St.—will receive bids until Dec. 12, for machine and woodworking equipment, etc. for proposed alterations to machine shop. Estimated cost $25,000.

Ont., Hamilton — Cole Lumber Co., J. H. Rutherford, Mgr., Bartonville—prices on complete equipment for lumber mill and lumber yards destroyed by fire. Loss $100,000.

Opportunities for Future Business

Calif., Compton—Alco Oil Tool Co., 16516 Avalon Blvd., awarded contract for 1 story, 60 x 350 ft. addition to plant. Estimated cost $40,000. Private plans.

Calif., Los Angeles—Victor Talking Machine Co., North Sycamore Ave., awarded contract for a 1 story, 90 x 161 ft. addition to factory. Estimated cost $75,000.

Calif., Oakland—L. E. Van Ness, 4920 Park Blvd., will build a machine shop at South 8th and East Brush Sts.

Calif., San Francisco—Supt. of Lighthouses, is receiving bids for the construction of a warehouse and shop building at Goat Island Lighthouse Depot, Goat Island. Noted Nov. 28.

Colo., Pueblo—Colorado Fuel & Iron Co., A. Raeder, Denver, has made appropriation of $1,000,000 for adding 46 coke ovens to present battery of ovens at Minnequa steel plant.

Conn., Meriden — Humphrey Chevrolet Co., 103 Colony St., plans the construction of a sales and service station. Estimated cost $50,000. Lorenze Hamilton Inc., 22 Church St., Archt.

Conn., Waterbury — American Brass Co. awarded contract for a 1 story addition to shop and two frame lumber sheds, each 200 ft. long.

Fla., Jacksonville—Dutch Shell Oil Co., St. Louis, Mo., is receiving bids for the construction of an administration building, automotive building, garage, etc. at Phoenix Park here. Estimated cost $150,000.

Ill., Chicago—Gerrard Co. Inc., 1942 South 52nd St., Cicero, manufacutrers of tying machines, awarded contract for a 2 story, 133 x 233 ft. factory at 2915-17 West 47th St., here. Estimated cost $90,000.

Ill., Danville — Electrical Coal Mining Machinery Co., R. G. Reed, Pres., 309 St. Johns Court, Chicago, plans the construction of a new factory here.

Ind., Connersville—Central Mfg. Co., manufacturers of automobile bodies and seats, awarded contract for the construction of a 100 x 200 ft. factory. Estimated cost $43,000.

Ind., Indianapolis—Leader Specialty Co., 515 East Walnut St., awarded contract for a 42 x 112 ft. factory at 5321 Winthrop Ave. Estimated cost $46,000.

Ind., Speedway City — Electric Castings Co. awarded steel contract for a 1 story, 54 x 200 ft. factory. Estimated cost $44,000.

Ia., Cedar Falls — Viking Pump Co., plans immediate construction of a 2 story, 52 x 152 ft. addition to factory to increase capacity.

Ky., Louisville—Ditto-Johnson Motor Co., Floyd and Broadway, awarded contract for the construction of a 1 story garage at Bardstown Rd. and Grinsted Dr. Estimated cost $75,000. Noted Oct. 17.

Ky., Morehead—Eastern State Normal School, will receive bids until Dec. 20, for a 3 and 4 story school including manual training department, etc. Estimated cost $200,000. Joseph & Joseph, Breslin Bldg., Archts. and Engrs.

Md., Baltimore—Consolidated Instrument Co., Baltimore and Central Sts., plans addition to plant. Estimated cost $75,000. E. H. Glidden Jr., American Bldg., Archt.

Mass., Indian Orchard—Chapman Valve Mfg. Co., plans a 75 x 152 ft. addition to steel foundry. Will install new core, mold-drying and annealing ovens for use of oil in place of electricity in present steel foundry.

Mass., Lowell—B. H. Wiggin Co., 134 Market St., plans the construction of a 3 story factory and shop at 150 Market St. Estimated cost $40,000. Private plans.

Mass., New Bedford—Taunton & New Bedford Copper Co., 24 North Front St., is receiving bids for addition and alterations to factory. Estimated cost $40,000. Private plans.

Mass., Salem—Almy, Biglow & Washburn, 188 Essex St., is having preliminary sketches made for the construction of a 1 story garage and repair shop. Estimated cost $40,000 to $50,000. W. H. Gunt & Son, 208 Essex St., Archts.

Mass., South Boston (Boston P. O.)—E. T. Wards Sons Co., 44 Farnsworth St., manufacturers of iron and steel, awarded contract for a 1 story, 75 x 235 ft. factory at 64 Old Colony Ave. Estimated cost $45,000.

Mass., Springfield—American Bosch Magneto Corp., manufacturers of radio sets and automotive equipment, plans addition to plant to include departments for heat treating and scrap reclamation, also additional storage and shipping facilities.

Mass., Winchendon—General Box Co. awarded contract for a 2 story, 60 x 160 ft. addition to factory.

Mich., Lansing—Motor Wheel Corp., South Saginaw St., is having plans prepared for the construction of a 2 story, 80 x 480 ft. factory for the manufacture of automobile wheels. Estimated cost $250,000. Private plans.

Mo., Columbia—Missouri Survey Commission, recommended appropriation of $8,200,000 for a group of buildings, to be expended within ten years, including service shop and warehouse, $80,000, for Missouri University.

Mo., Springfield—Springfield Tablet Mfg. Co., 300 North Jefferson St., awarded contract for 1 and 2 story, 60 x 120 and 50 x 60 ft. factory and office.

N. J., Edgewater—Ford Motor Co., E. Ford, Pres., Detroit, Mich., awarded contract for the construction of a 2 story, 260 x 1,500 ft. assembly plant, etc. here. Estimated cost $1,000,000. Noted Oct. 24.

N. J., Florence—R. D. Wood Co., 400 Chestnut St., Philadelphia, Pa., will soon award contract for the construction of a 1 story, 105 x 240 ft. machine shop here. Private plans.

N. J., Highbridge — William Prym Co. of America, 16 West 19th St., New York, N. Y., manufacturers of metal goods, plans the construction of a factory here. Estimated cost $200,000.

N. J., Jersey City—I. Williams Corp., c/o C. M. Eagan, 15 Exchange Pl., is having plans prepared for the construction of a 6 story garage at 645-47 Ravonia Ave. Estimated cost $150,000. Architect not announced.

N. J., Newark—Public Service Co., 80 Park Pl., will build a 1 and 2 story, 95 x 375 ft. garage, etc. at 924 Broadway. Estimated cost $150,000. Private plans.

N. J., North Bergen—Township Commission, Municipal Bldg., will receive bids about Dec. 23, for a 3 story, 90 x 110 ft. garage and signal station. Estimated cost $150,000. R. B. Glenn, Municipal Bldg., Archt. and Engr. Noted Oct. 17.

N. Y., Marilla — Buffalo Sintering Corp., awarded contract for addition to factory. Estimated cost $175,000.

N. Y., New York—Edwards & Co., Exterior St. and 140th St., manufacturers of electrical signaling devices, awarded contract for the construction of a 3 story factory. Estimated cost $75,000.

N. Y., New York — J. J. Gilhully, 13 East Gunhill Rd., will not construct 2 story, 100 x 112 ft. garage at Webster Ave. and 204th St. $40,000. Project abandoned. Noted Nov. 14.

N. Y., New York — Tremont Hall Co., C. Hirsch, Secy., 255 Haven Ave., is receiving bids for the construction of a garage at 3rd Ave. and 170th St. Estimated cost $40,000. C. Goodman, 375 Fulton St., Brooklyn, Archt.

N. Y., Richmond Hill—Metz Bros., 129th St. and Metropolitan Ave., plans the construction of a 112 x 240 ft. garage. Estimated cost $40,000. W. Doyle, 11 John St., New York, Archt. Maturity April 1930. Noted Nov. 28.

Okla., Oklahoma City — Oklahoma Sash & Door Co., 8 East Grand St., is having preliminary plans prepared for the construction of a 2 story factory at 17th St. and Broadway. Estimated cost $150,000. Architect not selected.

Okla., Sand Springs—Protective Metals Co., is having plans prepared for the construction of a new sheet metal plant. Estimated cost $100,000.

Pa., Altoona—Altoona & Logan Valley Electric Co., plans additions and alterations to automotive garage and repair shop, etc.

Pa., Pittsburgh — Firestone Tire & Rubber Co., 1286 South Main St., Akron, O., will soon award contract for a 3 story sales and service building at Baum Blvd. and Roup and Stratford Sts. Estimated cost $250,000. Lockwood Greene Co., 1566 Hanna Bldg., Cleveland, O., Engrs. Noted Nov. 28.

R. I., Providence — Providence Cadillac Co., 9 Federal St., are receiving bids for a 2 and 3 story, 125 x 215 ft. garage and repair shop. Estimated cost $200,000. A. Kahn, Marquette Bldg., Detroit, Mich., Archt.

Tenn., Franklin—Allen Mfg. Co., 300 10th Ave. N. Nashville, awarded foundation and steel contracts for foundry here. Estimated cost $200,000. Robert & Co., Bona Allen Bldg., Atlanta, Ga., Engrs.

Tex., San Antonio—International Harvester Co. of America, Harvester Bldg., Chicago, Ill., will soon award contract for the construction of a 2 story, 87 x 250 ft. branch factory at South Flores and Peden Sts., here. Private plans.

Utah, Ogden—Bidglow Hotel Corp., awarded contract for the construction of a garage on 25th St. Estimated cost $50,000.

Wash., Seattle—Washington Box & Veneer Co., plans the construction of a new veneer manufacturing plant on 20 acre site on East Marginal way to include three large factory buildings, one to house sawmill for cutting cores.

Ont., Leaside—Trane Co. of Canada, Ltd., 439 King St. W., Toronto, plans the construction of a 2 or 3 story factory for the manufacture of heating specialties on Soudan Ave. Estimated cost $100,000. Architect not selected.

Que., Montreal—Canadian Foundry Supplies, Ltd., 185 Wellington St., plans addition to foundry. Estimated cost $60,000.